World Petroleum

JULY, 1950 Canadian Review Number

One Dollar

WARREN'S *Stabilized* NATURAL GASOLINE

OR STA-VOL-ENE

for EXTRA ENERGY

OR

ANY EMERGENCY

The need for quicker action, instant speed, greater energy and dependability is no longer confined to the police and fire departments or ambulances. Today's traffic presents this problem every hour on any highway, street intersection or airport.

The demands for more power, action and energy to match the fast-moving tempo of highway traffic and modern industry are being met with Warren's Stabilized Natural Gasoline. Blend with Warren's to insure a stabilized product with higher octane and lower cost. It has fine lead susceptibility.

NATURAL GASOLINE
Butane
Propane
Iso-Butane
Iso-Pentane
Hexane
Heptane
STA-VOL-ENE

WARREN PETROLEUM CORPORATION

Producers, Manufacturers, Exporters and Marketers

Export Terminals: Corpus Christi, Port Arthur, Baytown, Texas City, and Norsworthy, Houston, Texas.

TULSA 2, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

Crude Oil, Natural Gasoline and Liquefied Petroleum Products

Vessels for Scottish Oils Refinery are made of stainless steel

Below: Close-up view of 30-in. diam. dished and flanged top head on one of the two 9-ft. 3-in. diam. by 52-ft. 2-in. reactors shown below. Both the head and the flange are made of A-285 Grade C Firebox Steel and are lined with nickel.

The top head of the catchpot (center vessel in the view below) is also made of A-285 steel but is not lined with nickel.

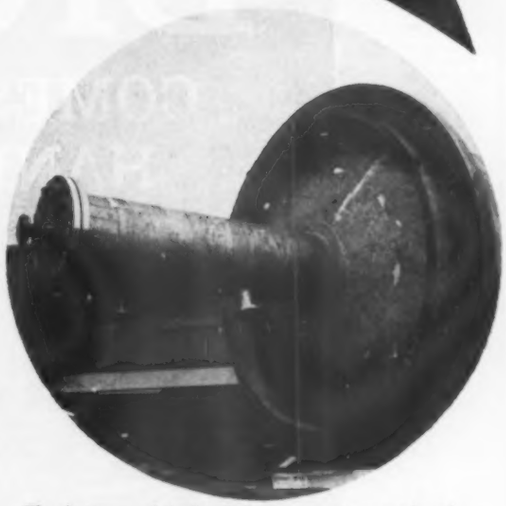
The large illustration below shows two 9-ft. 3-in. diam. by 52-ft. 2-in. phosphoric reactors and one 8-ft. 6-in. diam. by 35-ft. 9-in. catchpot which we built for Scottish Oils, Limited, at Grangemouth, Scotland.

The cylindrical portion of each of these vessels is made entirely of ASTM-A-240 Grade M, Type 316, modified stainless steel. The materials used for the top head and bottom of each vessel are described in the captions.

Several other alloys were required for fittings and piping connections. A number of internal grid plates in the structures are made of solid nickel. Some of the nozzles and other forgings are made of stainless steel, some of Hastelloy and some of A-181 Grade 1 forged steel with nickel linings.

The handling of such a variety of alloys obviously involved the solution of special and unusual problems in fabricating and welding. It also indicates that we have the production experience, the skilled personnel, and the complete shop facilities to build the specialized alloy structures so often needed by the petroleum industry.

In addition to specialized structures like these, we also built flat-bottom storage tanks, pressure storage tanks, and tanks equipped with floating roofs. Write our nearest office for quotations.



The bottoms of both of the reactors are made of ASTM-A-240, Grade M, Type 316, modified stainless steel. The cylindrical drain pipes extending downward from the center of the bottoms of these vessels, one of which is shown above, are made of ASTM-A-240, Grade M, Type 316, modified stainless steel and lined with Hastelloy.

The bottom of the catchpot is made of ASTM A-240, Grade M, Type 316, modified stainless steel. The drain pipe extending from the bottom of this vessel is also made of Grade M, Type 316, modified stainless steel and has a nickel lining.

All welded joints were x-rayed and the completed vessels were tested hydrostatically.

Below: Two phosphoric reactors and one catchpot ready to leave our Birmingham plant for the Scottish Oils, Limited refinery at Grangemouth, Scotland.

CHICAGO BRIDGE & IRON COMPANY

Chicago • Houston • Tulsa • San Francisco • Birmingham • Atlanta • Cleveland • Philadelphia • Los Angeles • Salt Lake City • Boston • Seattle • Detroit

Plants: Birmingham, Chicago, Salt Lake City and Greenville, Pa., U.S.A. Export Office—165 Broadway Building, New York 6, N. Y., U.S.A.

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COMES IN HANDY!

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PEARL HARBOR surprised and shocked America. What happened after that surprised and *flattened* the Axis!

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In Petroleum, companies like Socony-Vacuum with armies of technicians and workers, vast modern equipment, converted almost overnight to war production.

For example, by March, 1945, the wartime peak, the petroleum industry had increased annual output of aviation fuels (all grades) by more than 40 times over 1940! And during the same period, Socony-Vacuum *multiplied, by over 70 times*, its output of special high octane aviation gasoline, one of U. S. A.'s most potent weapons of World War II . . . with volume zooming from less than 300,000 barrels a year to a staggering rate of 20,000,000 barrels!

Today, by public demand, America is producing petroleum products at the yearly rate of over 2,080,000,000 barrels—and Socony-Vacuum is proud of the bigness that enables it to do its part.

The Flying Red Horse Companies

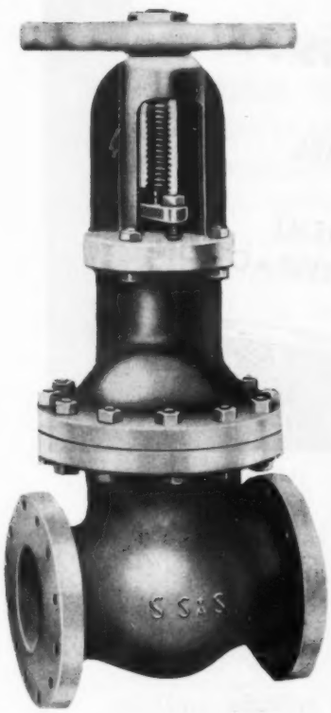
SOCONY-VACUUM OIL COMPANY, INC., and Affiliates:

MAGNOLIA PETROLEUM COMPANY • GENERAL PETROLEUM CORPORATION

SOCONY-VACUUM

BIGNESS SERVES AMERICA—PROTECTS AMERICA!

Valves and Fittings for the Oil and Allied Industries



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WE ARE SPECIALISTS IN THE MANUFACTURE OF:—

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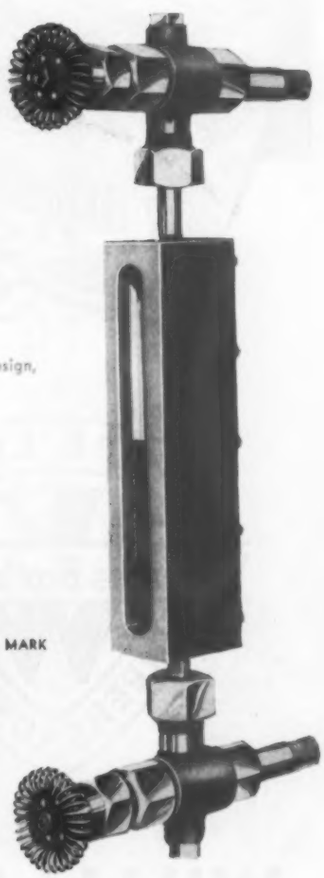

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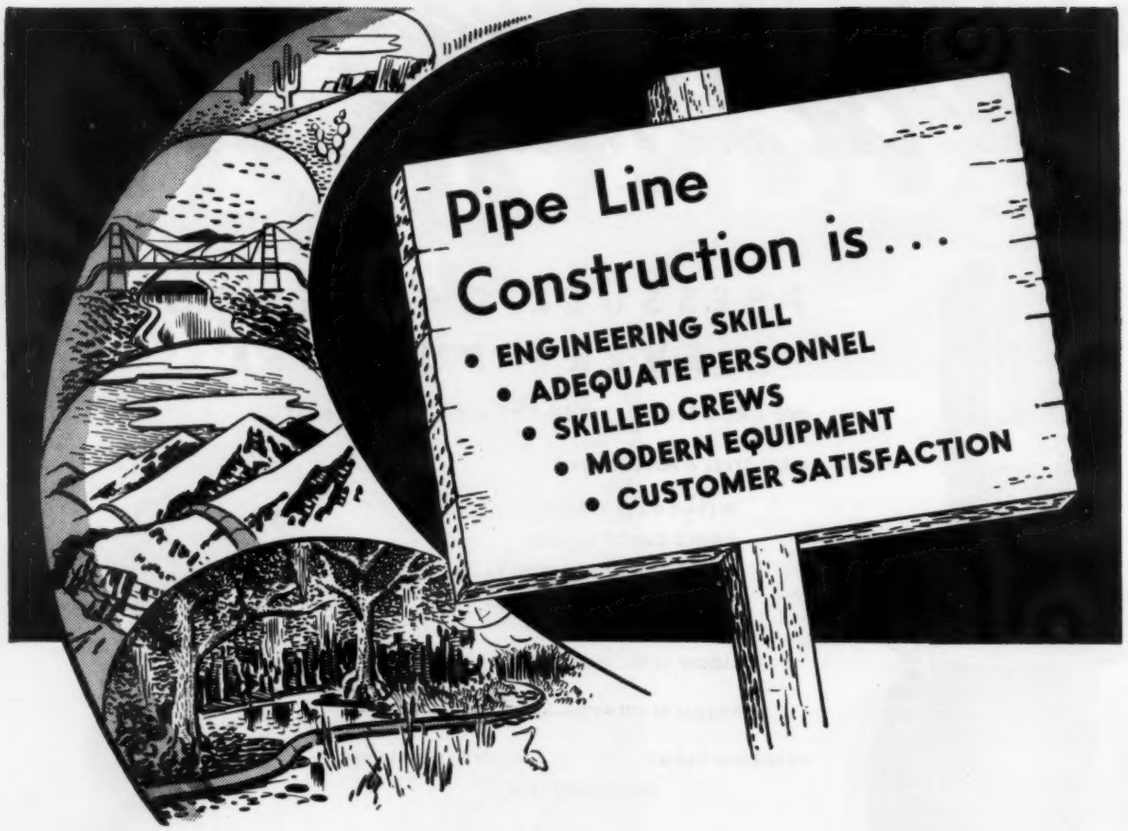

PIPE LINE ENGINEERS
Williams Brothers Corp.
CONTRACTORS

Through the toughest terrain and climatic conditions Williams Brothers Corp. has built pipe lines—through mountains and forests — swamps and deserts — on three continents—the past 35 years. Experienced engineers and mechanics, skilled construction crews and modern machinery enable Williams Brothers to plan and engineer pipe line construction over the shortest, safest and *most direct route* from producing fields to refineries, export terminals and consumer markets.

WILLIAMS BROTHERS CORP.

ENGINEERS — CONTRACTORS

OIL • Gas • Gasoline • Water

Pipe Lines and Pump Stations

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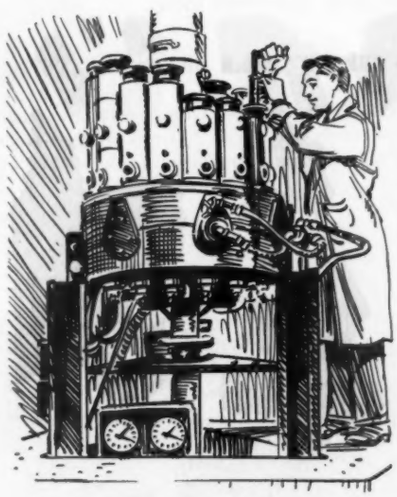
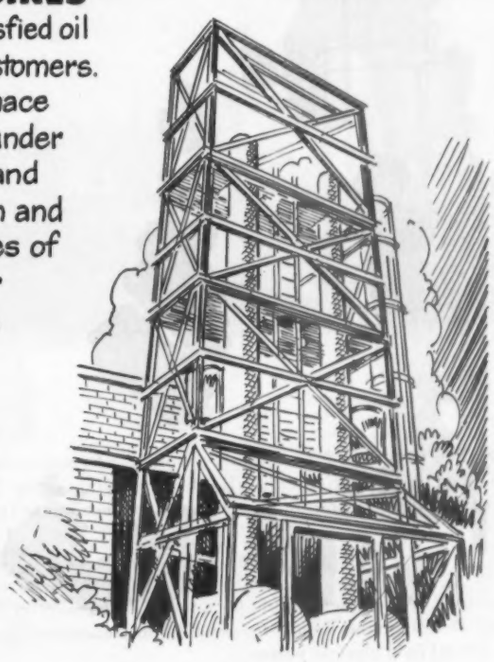
Speaking of Research... by ETHYL

ROAD RATINGS WITHOUT ROAD WORK. Winter or summer, rain or shine, this special chassis dynamometer quickly gives road antiknock ratings important to refiners producing fuels for today's and tomorrow's cars.



BETTER ENGINES mean more satisfied oil and gasoline customers. This special furnace permits study under tensile stress and alternating high and low temperatures of alloy steels for use in engines.



With these stills Ethyl separates gasoline into fractions. These are reblended into experimental fuels for evaluation in cars as a guide to **FUTURE FUEL COMPOSITION.**

Since 1923—*continuous research to provide better antiknock service*

ETHYL CORPORATION
RESEARCH LABORATORIES

Detroit, Michigan
1600 West Eight Mile Road

San Bernardino, California
2600 Cajon Road

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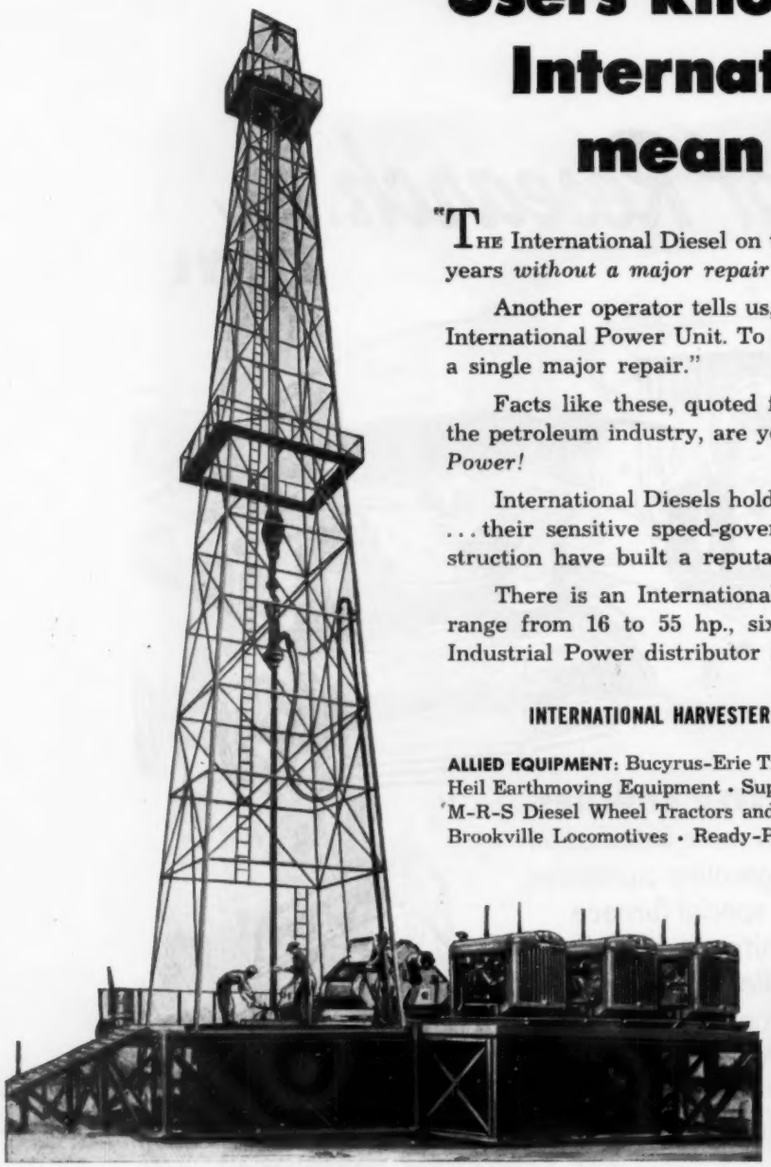
Users know— International Diesels mean Productive Power!



"The International Diesel on this pumping installation has been working for 6½ straight years *without a major repair job!*" one user said.

Another operator tells us, "Neither the head or pan has ever been removed on our International Power Unit. To date it has given us 1095 days of 24-hour operation without a single major repair."

Facts like these, quoted from performance reports of enthusiastic users throughout the petroleum industry, are your best guide to efficient, productive power—*International Power!*

International Diesels hold costs to the minimum. They deliver full-rated horsepower ... their sensitive speed-governing system, efficient lubrication, and overall rugged construction have built a reputation for superior performance and long-lived stamina.

There is an International for every oil field requirement. Five carburetor models range from 16 to 55 hp., six Diesel models from 39 to 180 hp. Your International Industrial Power distributor has the facts. See him today.

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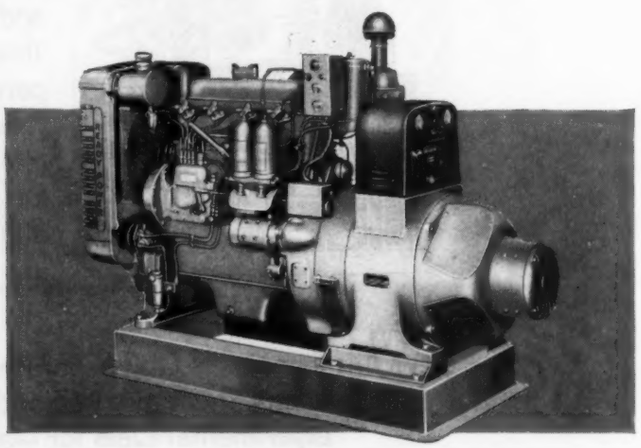
ALLIED EQUIPMENT: Bucyrus-Erie Tractor Equipment · Isaacson Landclearing and Earthmoving Equipment Heil Earthmoving Equipment · Superior Sidebooms and Angle Fillers · Hughes-Keenan Tractor Cranes M-R-S Diesel Wheel Tractors and Mississippi Wagons · Hough Payloaders · Trojan Road Maintainers Brookville Locomotives · Ready-Power Engine Generators.

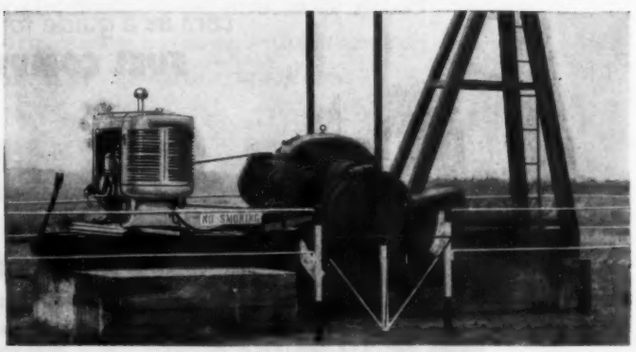


★

Above: The exclusive International gasoline-conversion starting system gets these International UD-24 Power Units going fast on this drill rig. Such multiple units provide flexible, economical power.

★

Above right: A complete range of sizes plus economy of International Diesels make Ready-Power Engine Generators popular choice for oil field electric power.



★

Right: Continuous, dependable power from an International UD-6 keeps costs down and the oil flowing on this pumping installation.

INTERNATIONAL INDUSTRIAL POWER

INTERNATIONAL HARVESTER

CRAWLER TRACTORS
WHEEL TRACTORS
POWER UNITS

BIT BY BIT NONE ARE BETTER THAN Security

Every Security 3-Cutter Rock Bit embodies the manufacturing skill and craftsmanship acquired through two decades of manufacturing know-how. Strict metallurgical control provides the right combination of steels for longest possible life—tough steels in the bit body to absorb heavy loads—hard-surfaced steels with ductile cores in the cutters for wear and shock resistance.

The most modern manufacturing equipment combined with exacting engineering standards give Security 3-Cutter Rock Bits "built-in" characteristics which mean uniform dependability, utmost bit life and full gage hole per bit.

3 CUTTER* ROCK BITS

Type S3. Designed for rapid penetration in soft formations, S3 cutters feature exceptionally long, widely-spaced teeth arranged to minimize tooth contact on bottom and facilitate effective cleaning.

Type S6. Designed for fast cutting with light or heavy weights in medium shales, gypsum, salt, chalk, anhydrite, medium lime and unconsolidated formations.

Type M3. For drilling medium formations which may be found too hard for the S6 Bit. Recommended for drilling in formations such as sand, medium shales, medium hard lime and conglomerates.

Type M5. Imparts a chipping and crushing action for effective penetration. Teeth are closely spaced and sturdy in section. Typical formations involve hard lime, hard shale, dolomitic lime, slate and hard anhydrite.

Type H7. For drilling extremely hard abrasive formations. Maximum gage protection is provided by circumferential webs connecting adjacent heel teeth around the gage cutting ends of the cutters.

Send for your free copy of the Security 3-Cutter Rock Bit Catalog.

* *These products are not for sale in the United States or its territories.*

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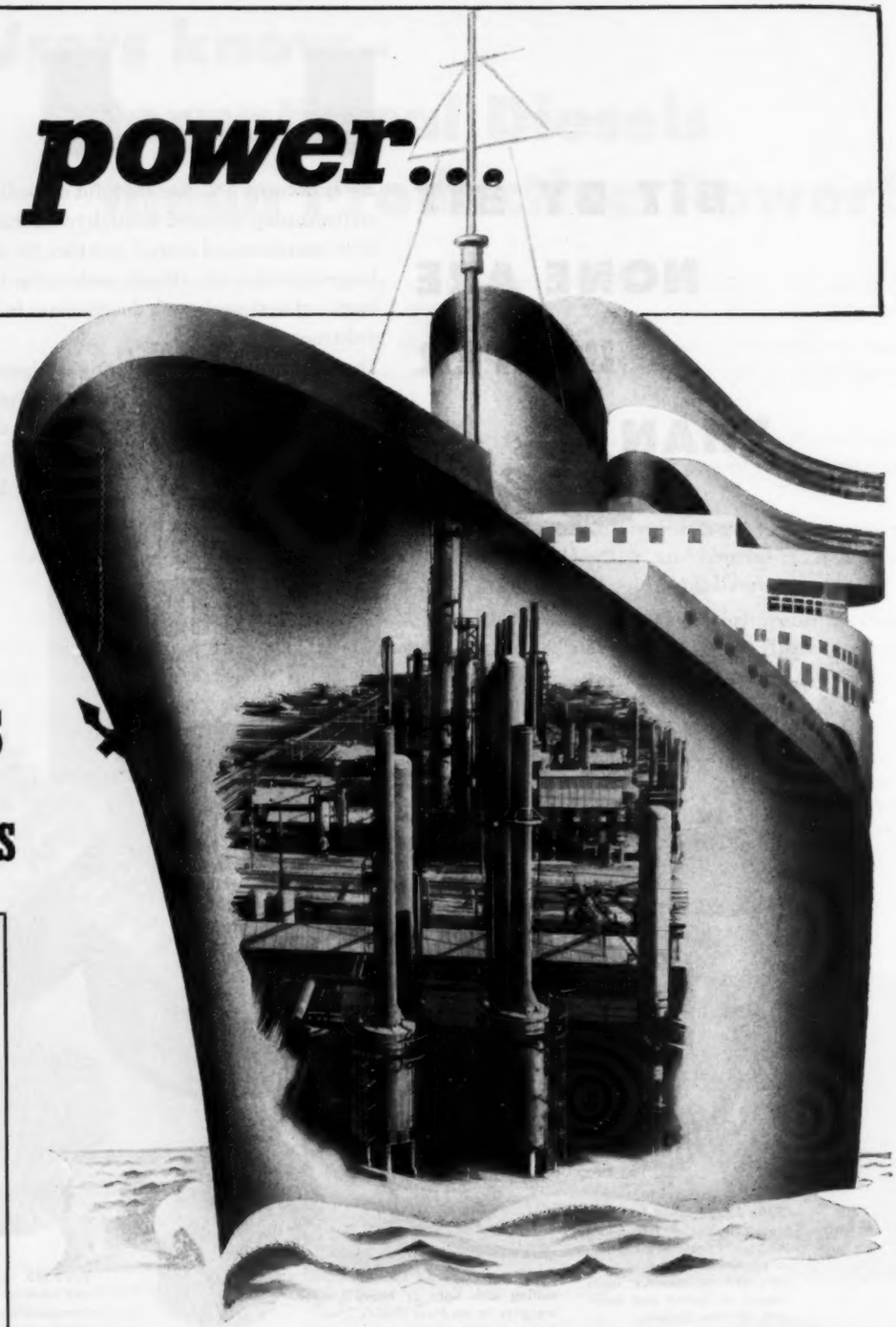
3-CUTTER ROCK BITS

Oil is *power*...



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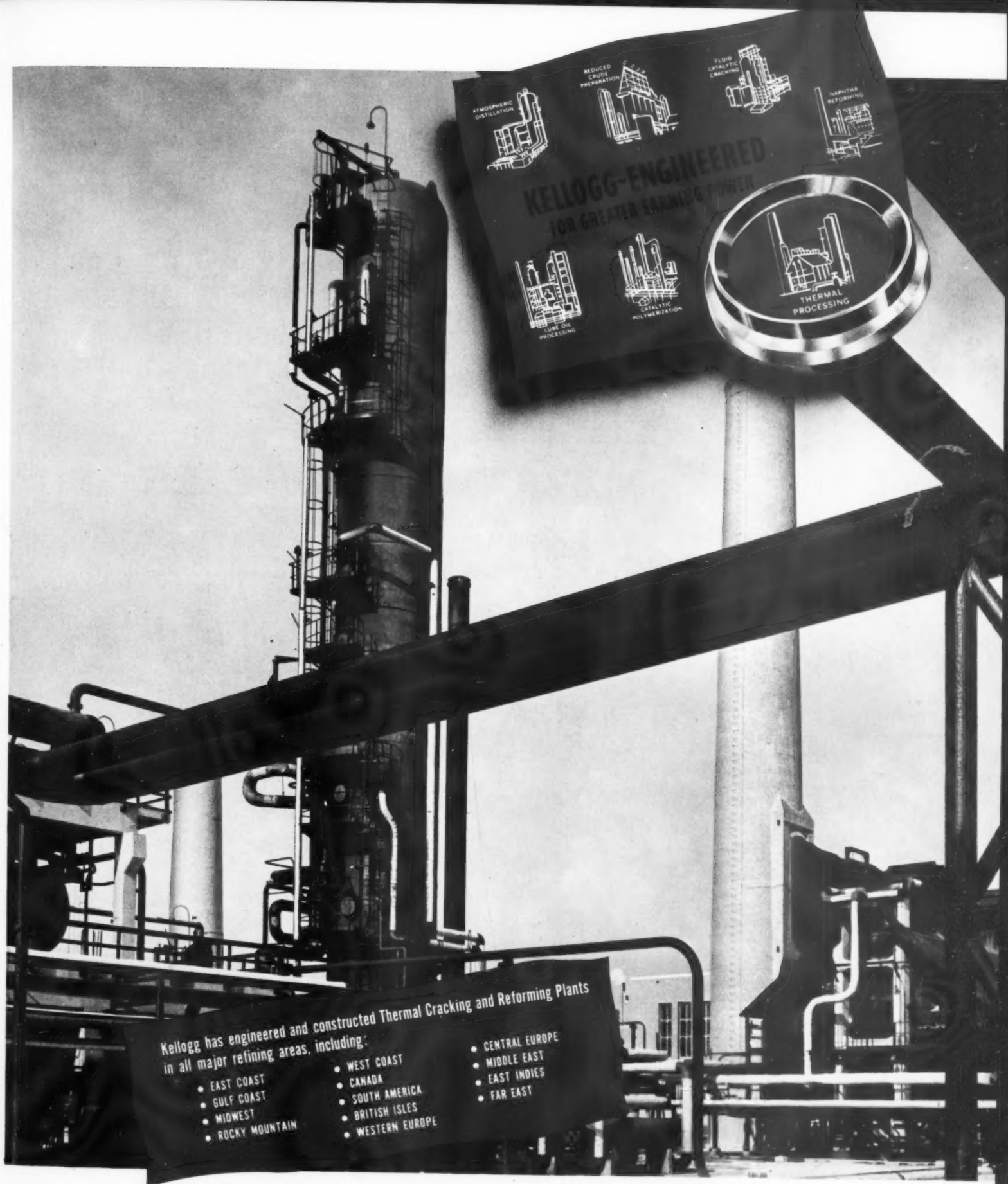


Now, more than 250 Thermal Crackers and Reformers have been engineered and constructed by Kellogg!

Yes! Kellogg-built Thermal Crackers and Reformers number more than 250... and more units are under construction on two continents!

KELLOGG'S first contribution to thermal cracking was the superior, hammer-welded Burton Still more than thirty years ago. The Cross and other thermal processes followed in rapid succession, and even by 1930 Kellogg had built more than 100 units from Brooklyn to Okmulgee.

In cooperation with major oil companies, through the Gasoline Products Company, Kellogg has continued to refine thermal cracking methods over the years — contributing to such other forms as delayed coking and further adapting the process to thermal reforming of naphthas. Still the most economical means of producing medium-octane fuels and of breaking down the heavy ends, thermal cracking is expected to play a major role in refining for years to come.

The data, experience and know-how acquired by Kellogg in this continuous, thirty-year association with the basic thermal refining process will prove valuable to any refiner contemplating thermal additions or modernizations.

COMMERCIAL OPERATING DATA IS THE MAJOR DEVELOPMENT WEAPON!

With such variables as cold oil velocity, flow direction, heat per square foot, pressure, temperature of flue gases and furnace efficiency to be coordinated with wide operating flexibility, the designing of cracking and reforming furnaces to maintain long runs at low operating costs — without loss of efficiency through coking — is no mean task. Increased understanding of basic theory and improved basic engineering have contributed much to thermal cracking efficiency. But the reams of data acquired from commercial operating plants provide the soundest base on which to design new units. With a vast amount of this information at hand, accumulated over a thirty-year period and covering the widest possible range of applications, Kellogg is in a unique position to assist refiners.

IT TAKES ALL SEVEN TO PRODUCE GREATER EARNING POWER...

1 THE DEVELOPMENT "TOOLS" —laboratories, pilot plants and recognized specialists to prove and improve processing and equipment ideas.

2 PROCESS ENGINEERING by three distinct groups of specialists—*sequence* engineers, *unit* engineers and *development* engineers—supported by an extensive reservoir of exclusive data.

3 SPECIALISTS IN EVERY PHASE of design engineering due to the completeness of Kellogg's engineering staff.

4 SPECIALIZED BUYERS backed by the cumulative buying power of the largest company in the business.

5 COMPLETE FABRICATING FACILITIES to make schedule deadlines and to develop workable "firsts" in refinery equipment.

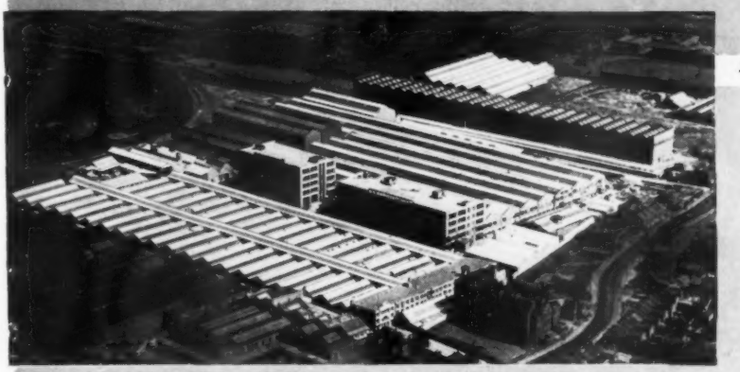
6 CONSTRUCTION KNOW-HOW acquired in completing hundreds of major jobs, plus an ample supply of the proper tools, and the constant development of new money-and-time-saving methods on the construction lot.

7. PRACTICAL OPERATING COUNSEL on all design and construction problems. Kellogg maintains in its engineering departments a large group of practical refinery operators. They have a three-fold function: *First*, they work with design engineers to "design in" those elements contributing to easy and fool-proof commercial operation; *Second*, they create the finished unit's "Operating Instructions"; *Third*, they conditions and supervise initial operation of the unit when construction is finished. Thus Kellogg designs incorporate the down-to-earth suggestions that come from day-in and day-out operation of units by practical operators.

...AND ONLY KELLOGG HAS ALL SEVEN!

The M. W. Kellogg Company, (a subsidiary of Pullman Incorporated), New York, Jersey City, Los Angeles, Tulsa, Houston, Toronto, London, Paris

There is a wide gap, measured in terms of both time and distance, between a drawing-board in Britain and an oilfield in Venezuela.



Harvey's Works

where the plans are laid,

In the immediate Postwar period, there was a gap, just as vast, between the production and supply of plant for the growing Oil Industry.

the parts assembled,

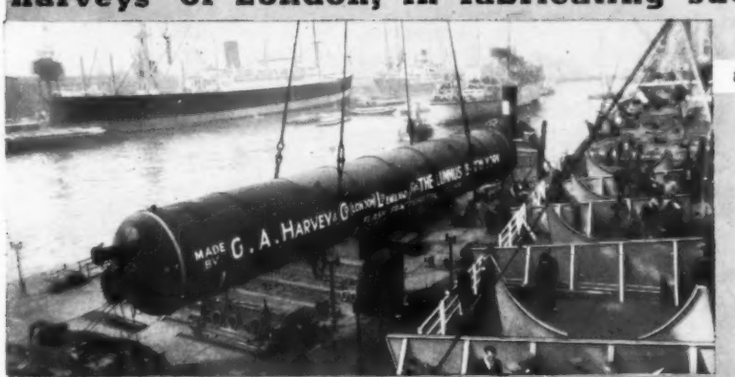
& the welding x-rayed.

But the need for Refinery Plant had been foreseen by Harveys of London; they instantly harnessed all the huge resources of their organisation

The column is transported,

with minor incidents,

and, by doing so, reaped the reward of their foresight and enterprise. Harveys of London, in fabricating such items as Fractionating Columns,



to be loaded at London Docks

& off-loaded off Venezuela.

are triumphantly meeting the urgent needs of Oil Producers and Refiners.

These Fabrication and Transport scenes are, in part, taken from a Shell series covering the whole operation of producing Oil Plant.

G. A. Harvey & Co (London) Ltd Woolwich Harvey Road London SE7

The Familiar Steel Courier becomes the Ambassador of Goodwill

NOW! COLOR PACKAGING FOR LARGEST STEEL SHIPPING CONTAINER!

New RHEEMCOTE Process Produces First Completely Lithographed and Inner Roller-Coated 55-Gallon Steel Drum

Color schemes, trademarks and designs, however intricate, may now be accurately reproduced on the biggest of all steel shipping containers.

Striking possibilities of the new, exclusive *Rheemcote* process, as shown above, are the result of years of Rheem research—and development of the world's largest metal-decorating press.

Remarkable for its merchandising value alone, the *Rheemcote* drum not only promotes—*it protects!*

A roller-coated lacquer lining seals the inner drum surface with glass-like purity . . . and thus opens the door to improved packaging for products which heretofore have been difficult to contain. New electric "Resistance" welding produces smooth, strong seams, eliminates scale and burn-off metal. A hard, lustrous, exterior finish assures utmost durability against severe weather and handling.

Users of steel containers may at last achieve uniformity of packaging – and the opportunity to billboard their products and name before the eyes of the world!

The Rheem Manufacturing Company, world's largest maker of steel shipping containers, is particularly proud to have developed the Rheemcote Process in this its 25th year of service to industry.

For a descriptive, beautifully illustrated brochure on this important contribution to marketing—write direct to Rheem today. No cost or obligation, of course.

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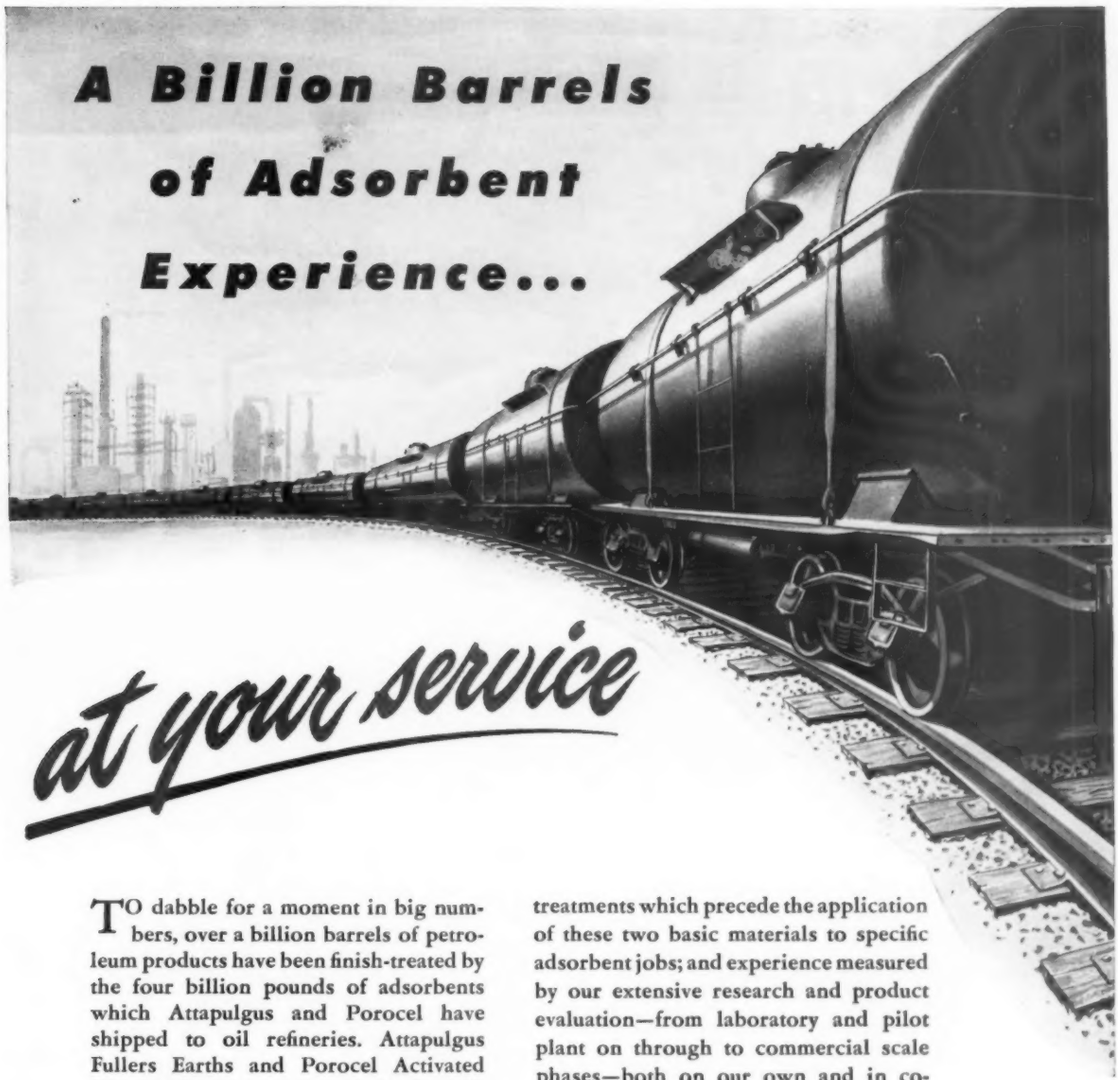

TO dabble for a moment in big numbers, over a billion barrels of petroleum products have been finish-treated by the four billion pounds of adsorbents which Attapulgus and Porocel have shipped to oil refineries. Attapulgus Fullers Earths and Porocel Activated Bauxites have become recognized standards in the removal or reduction of odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates, and for solid catalyst purposes. And in this wide range of services, remarkable finished value was gained in a long list of petroleum cuts—from the lightest distillates to the heaviest lubes and waxes.

This all adds up to a lot of adsorbent experience—experience with the many treatments which precede the application of these two basic materials to specific adsorbent jobs; and experience measured by our extensive research and product evaluation—from laboratory and pilot plant on through to commercial scale phases—both on our own and in cooperation with our customers.

So there's great merit to the suggestion that it pays to consult Attapulgus and Porocel. In your own plans to improve products or expand output, perhaps our one billion barrels of adsorbent experience can be of real help to you in selecting the right adsorbent and the right conditions. Our laboratory and process staff are at your service, without obligation.

ATTAPULGUS CLAY COMPANY *Fullers Earth* • **POROCEL CORPORATION** *Activated Bauxites*

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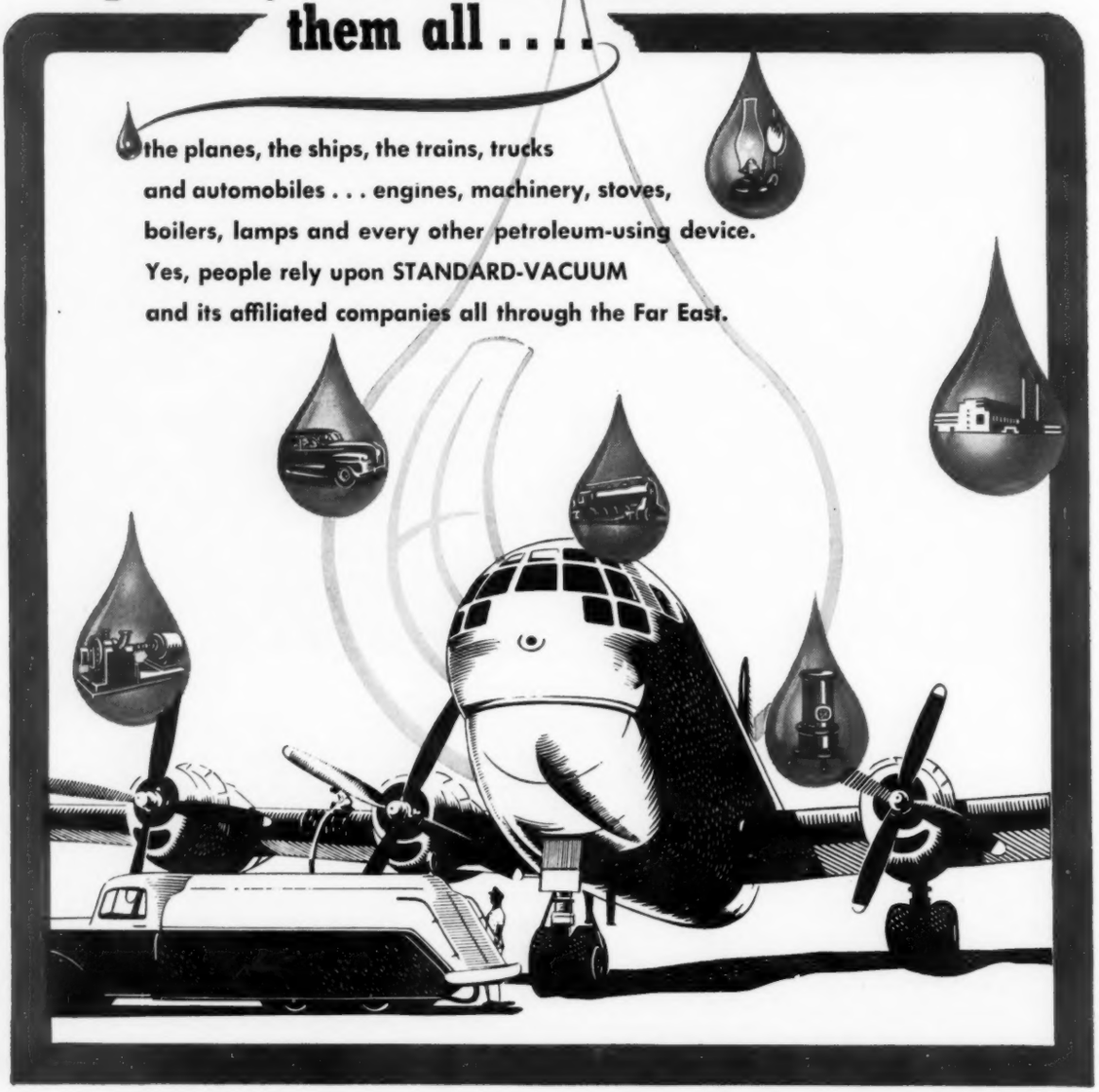
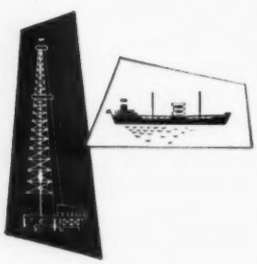
Standard-Vacuum
powers, fuels and lubricates them all . . . .



the planes, the ships, the trains, trucks
and automobiles . . . engines, machinery, stoves,
boilers, lamps and every other petroleum-using device.
Yes, people rely upon STANDARD-VACUUM
and its affiliated companies all through the Far East.



STANDARD-VACUUM OIL COMPANY

26 BROADWAY, NEW YORK 4, N. Y.

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KENYA • MADAGASCAR • MALAYA • NEW ZEALAND • PAKISTAN • PHILIPPINES
PORTUGUESE EAST AFRICA • RHODESIA • SOUTH KOREA • SOUTH PACIFIC ISLANDS
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another important project

designed and constructed by BORN

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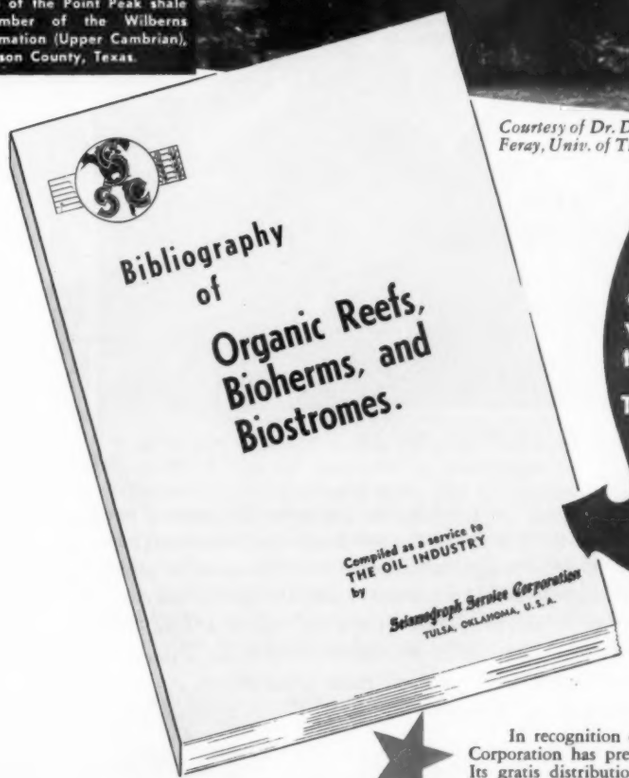
Stromatolitic bioherm at the top of the Point Peak shale member of the Wilberns formation (Upper Cambrian), Mason County, Texas.

Courtesy of Dr. D. E. Feray, Univ. of Tulsa



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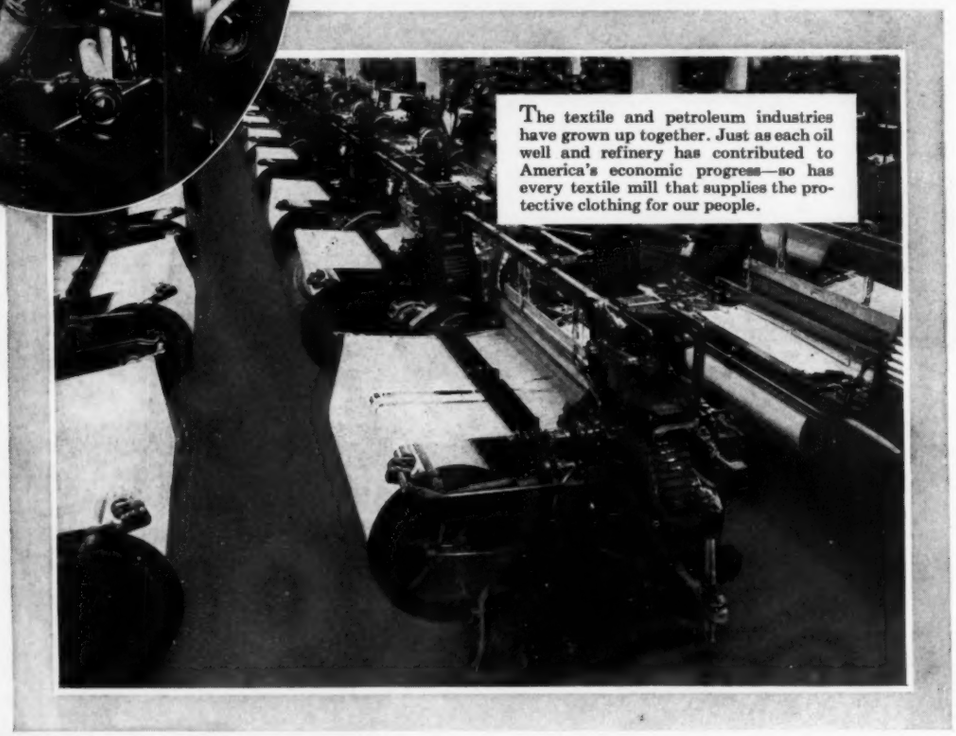

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For example, a recent poll among high school seniors shows that the majority of them believe that the owners of business take out for themselves a larger share of the income than is paid to employees. They think the stockholders' average return is 24% of the sales dollar. The truth is that stockholders average less than 3%, whereas over 30% of the income dollar is paid out as wages, pensions and other benefits.

Our young people do not seem to realize that paying dividends is only one function of profits. Far more important today is the need for profit to keep business competitive, and to pay for new buildings, machinery, and other necessary equipment and to provide new and more jobs. Ignorance of this fundamental concept breeds contempt for the system of enterprise that built our country and keeps it strong.

The facts of business must be given to our boys and girls to protect their future. Only business men can supply the facts. As a business leader in your community, it is your responsibility to help clear up such misconceptions. The old story that Nero fiddled while Rome burned must not have a counterpart in America.

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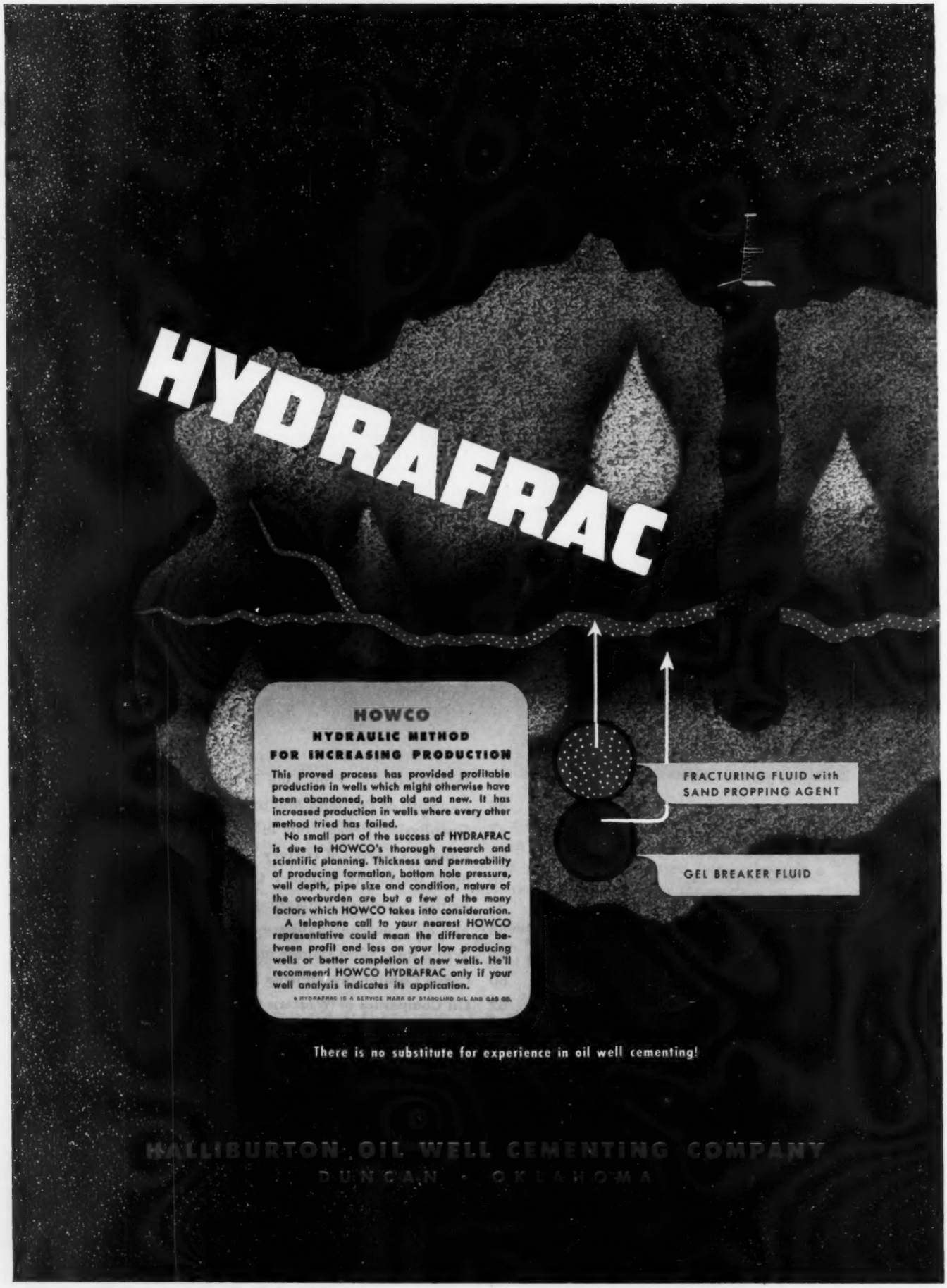
THIS-MONTH'S COVER

The cover illustration is a "moon's eye" view of Canada, the symbols representing oil refineries and centers of drilling activity.

Two pipe lines, one across Maine and the one under construction from Alberta to Lake Superior, are indicated in red.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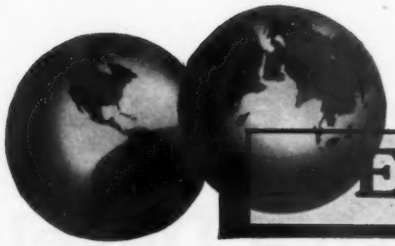


Editorial

Economic Significance of Canadian Oil

ONE of the arresting and significant oil industry developments of the past three years has been the emergence of western Canada as a front-rank producer of petroleum. The discovery of a prolific new oil field is always an exciting event. In this particular case, moreover, not merely the size of the productive area but especially the circumstances leading up to its finding appealed irresistibly to the imagination.

Alberta has long possessed a small but valuable oil field in Turner Valley. Over a period of thirty years it has produced an aggregate of over a hundred million barrels and has supplied the needs of neighboring markets. During all that time a more or less continuous search for additional sources of supply was carried on, and this exploratory effort was intensified as Turner Valley entered a gradual but persistent decline. One large Canadian company drilled over 130 wildcat wells and spent nearly $25 million in its quest. Some small production was found, but none on a scale to justify an expenditure of such proportions, and it is no secret that a decision to minimize or abandon its exploration was under consideration toward the end of 1946.

Then on February 13, 1947, Leduc No. 1, twenty miles southwest of the city of Edmonton, was brought in with heavy production and was quickly followed by similar flows from other nearby drillings which gave proof that a deposit of major proportions had been reached. In the following year a spectacular touch was given to the field when blowouts in Atlantic No. 3, the famous "rebel well," caused it to run wild, at an estimated rate of ten thousand barrels a day, for months before it could finally be subdued and killed. Because of its sensational features the story of Leduc has been widely told, and it started one of the great oil booms of recent times and brought the representatives of hundreds of oil companies as well as thousands of individual adventurers flocking to the scene.

The promise of Leduc No. 1 was quickly fulfilled by the discovery of a succession of fields that have made the names of Redwater, Golden Spike, Excelsior, Stettler and others familiar terms in the oil industry of the western world. Nobody yet knows the full potentialities of this new oil empire, but enough has been learned to make certain that, under the broad sweep of these western provinces, lies a vast treasury of hidden wealth that means much to the future, not only of Canada, but of the oil industry as a whole. As set forth in the following pages, the area in which geologic history and physical formations are favorable to the existence of oil is truly vast in extent, reaching from the foothills of the Rockies to the borderline of the great Canadian shield, and from the international boundary northward to the far reaches of the Arctic, the potential production region exceeding in size the four largest of the United States. Years of exploration and development will be necessary before the full significance of this new chapter in oil history can be known.

The most direct and immediate effect of these recent discoveries will be felt by the economy of Canada itself. Up to the present some 90 percent of the Dominion's oil requirements have been supplied from outside its own borders, largely by rail and pipeline from the United States but partly by ocean tankers from the Caribbean. For the present the existence of abundant petroleum deposits in western fields will make little change in this situation. Until economical means of transportation can be provided, oil from the prairies can move only to their near neighborhood, and production must be throttled down to local needs. Once the outlets now being pushed forward with all possible speed are completed, however, Alberta oil can move by pipeline to deep water and by tanker down the Great Lakes to refineries and markets in Ontario. Some of it may find its way to cities in the central and western states of the Union. Until the project for the St. Lawrence waterway takes form, however, eastern Canada probably will continue to use imported oil fed to Montreal refineries through the enlarged pipeline now being laid from Portland, Maine. The combined cost of the ocean-pipeline trip from South America will still be less than its movement from west to east through a line more than two thousand miles in length.

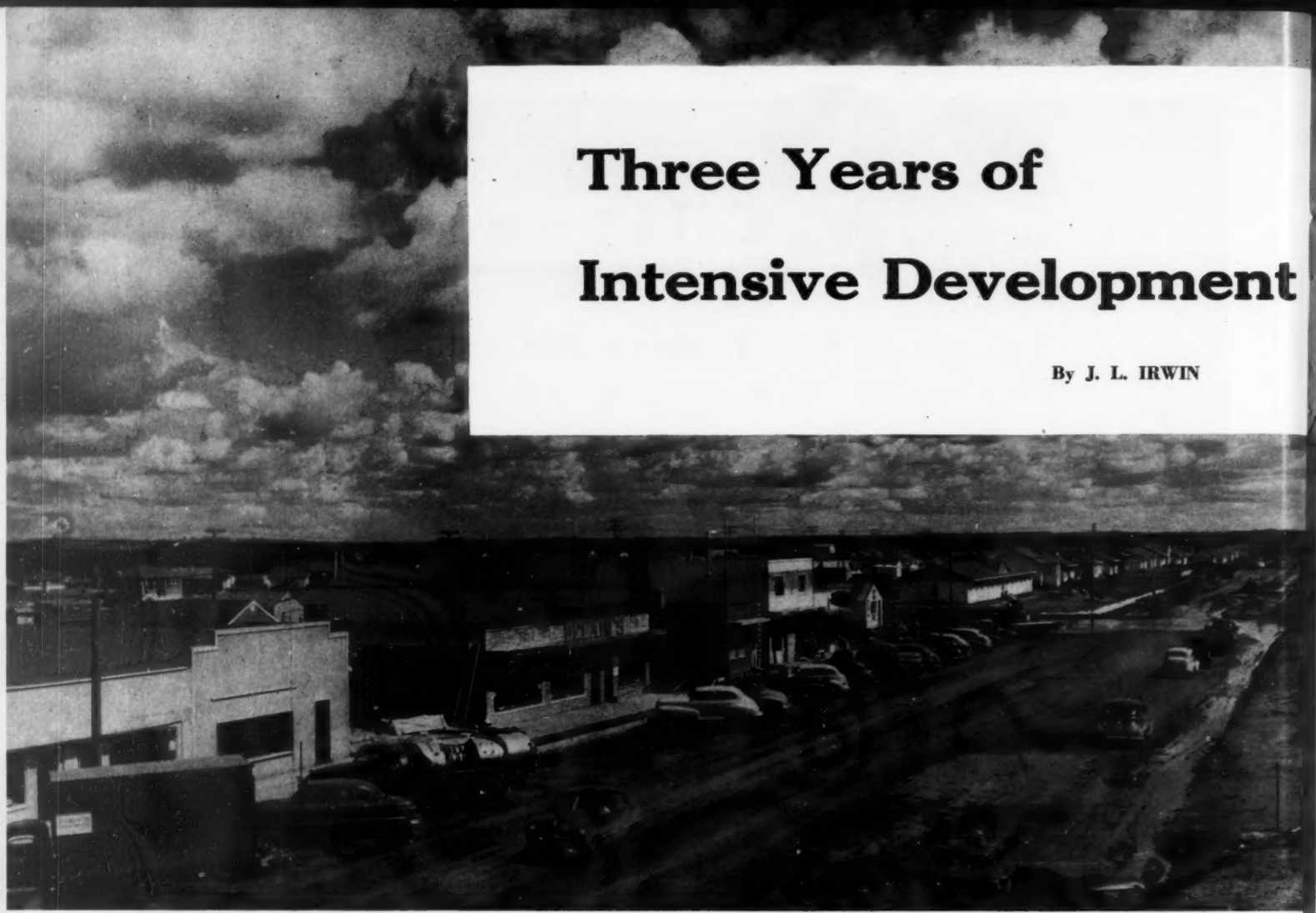
Similarly the natural gas, of which Alberta can supply an enormous quantity, will move through one or possibly several large lines to the northwestern states and the Pacific Coast region of Canada. The logical development would seem to be an exchange by which oil and gas from Canada would be shipped to certain areas in the United States now lacking adequate local production, while some crude and products would continue to enter Canada from the United States. In any case Canada would greatly reduce her annual dollar payments on account of oil.

More important to the Dominion than any such saving will be the stimulating influence of abundant indigenous supplies of relatively cheap fuel in the form of oil and gas. It will mean a rapid industrial development with the attendant growth of population, the establishment of new factories and power plants and the transformation of the great interior region from a purely agricultural economy to a more varied and stable pattern.

In a broader aspect the development of a flourishing petroleum industry in western Canada will be of strategic importance in strengthening the security of the whole North American continent. Should danger threaten the safety of its people in the future, it might come from a direction which would make the existence of a large oil supply in western Canada of inestimable value.

Three Years of Intensive Development

By J. L. IRWIN



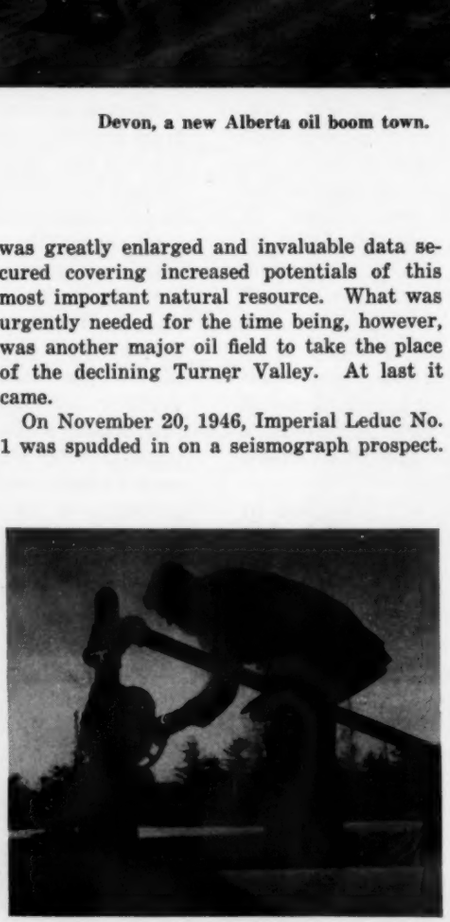
Devon, a new Alberta oil boom town.

ON February 13, 1950, the Leduc oil field of Alberta celebrated its third birthday. The celebration of an oil field's birthday is not as a rule regarded by the general public as an occasion for special attention, but this was a different sort of oil field.

The arrival of the great Leduc field came just ten years after Alberta had reached her peak production of over ten million barrels. In the ten years since 1936 the old valley was getting tired and beginning to suffer from the years of riotous living in its youth. Those had been days when nothing mattered but the present, when rules, regulations or restraint in development and production were unknown quantities, when flares roared and blazed year after year and valuable pressures were wasted.

By the time some sort of order was established, Alberta's oil was going down hill to a disquieting extent. It was then that Imperial Oil Ltd. stepped into the picture to begin a 10-year drilling campaign, during which it spent many millions of dollars in exploration throughout the province and drilled many hundreds of wells, none with success. Included in this huge and expensive program was the very considerable extension of the Kinsella gas field adjoining Viking which feeds Edmonton. The proven area was greatly enlarged and invaluable data secured covering increased potentials of this most important natural resource. What was urgently needed for the time being, however, was another major oil field to take the place of the declining Turner Valley. At last it came.

On November 20, 1946, Imperial Leduc No. 1 was spudded in on a seismograph prospect.

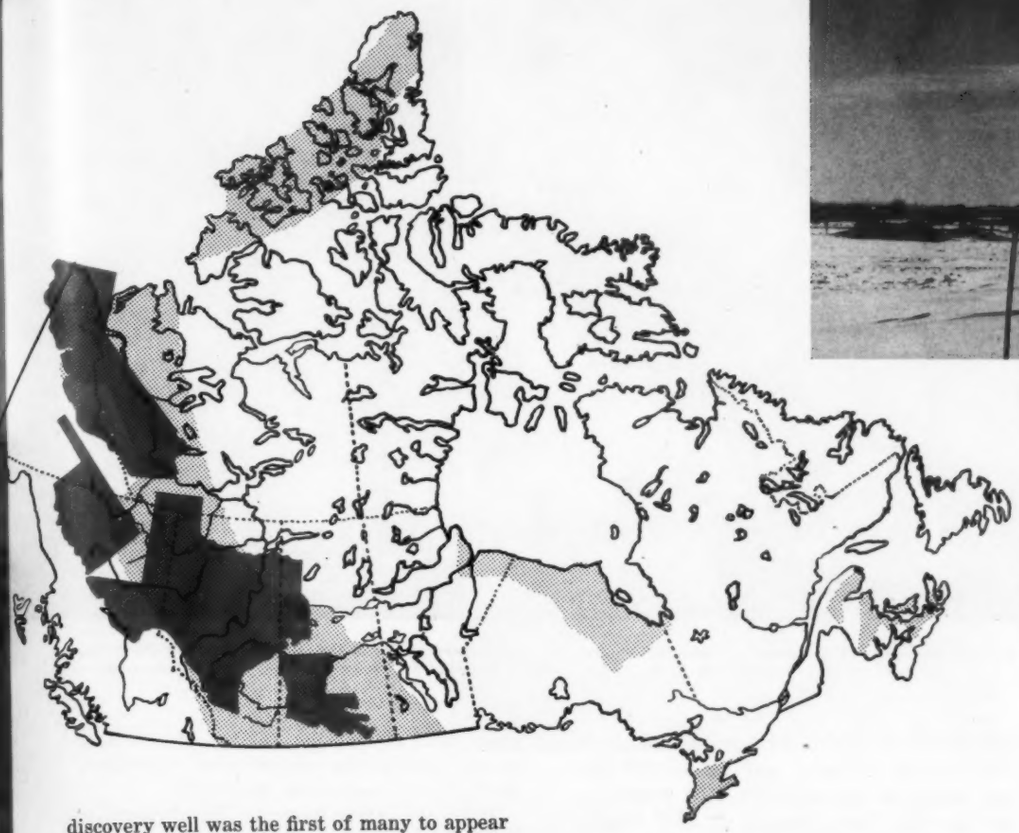


Simmons No. 1, one of 12 wildcats brought in as producers by Imperial Oil, Ltd., in 1949.

At 3,400 feet heavy gas pressure was encountered in the Viking sand at the base of the upper Cretaceous. Going slowly, with continuous coring, the well was carefully tested. The top of the Devonian limestone was reached at 4,390 feet. The next few hundred feet gave showings of gas, oil and water. This was followed by an Anhydrite bed and about 40 feet of red shale. The lime was reached again at 4,995 feet. Porosity developed, then increased, and drilling stopped at 5,066 feet for a drill-stem test.

The test was most encouraging. Gas was followed by a flow of greenish-brown, 40° gravity oil. Casing was set at 5,029 feet, the plug drilled and on Feb. 13, 1947, the discovery well was brought in. Flush production was made at the rate of 1,000 barrels a day, a new record for a prairie well. A large gathering of people which included government officials, members of Imperial Oil's family and the general public was present to witness the event.

The reason for giving in detail the completion of this one well is because of its significance from many different angles. It indicated that this might be the end of the ten-year search with all the expensive headaches with which it had been attended. Within a few months it was proved that the



Leduc No. 2 was located about two miles from Leduc No. 1, the discovery which started the current prairie campaign. Photo by Corsini for Standard Oil Co. (N. J.)

Comparison of the possible oil producing area, in western Canada with the principal producing states in the United States.

←

Northern Development Co. well drilling on the bank of the North Saskatchewan river near Devon, Alberta. Pollard photo for Caterpillar Tractor.

discovery well was the first of many to appear in a major new field which was continually expanding. Six miles away was the railway and sixteen miles to the north was Edmonton, capital city of Alberta. Two productive zones had been established in the Devonian—the D2 at around 5,000 feet and the D3 at around 5,300. Production from both was excellent with the latter predominating. Where two zones were proven, the regulation which calls for 40-acre spacing for one well permitted two, one to each zone, in 40 acres.

This was just over three years ago. Today there are over 400 producers at Leduc. Many of them possess a greater potential than the discovery well. A pipeline was laid within the first year, connecting the field with the railway at Nisku on the Calgary and Edmonton highway.

Roads in Leduc have been graded and graveled, signposts point out directions to all wells, the townsite of Devon in the field is on the river bank commanding an excellent view of the countryside and enjoying all modern facilities which include an excellent hotel, swimming pool and picture theater. The pipeline runs north from Nisku to Edmonton to connect with Imperial's refinery, brought down in sections from Whitehorse in the Yukon because of the Leduc discovery. It started refining around 6,000 barrels a day and is now running at 16,200.

On May 8 Hon. E. C. Manning, premier of Alberta, turned the sod for the construction of another major refinery in Edmonton in the vicinity of Imperial's plant. It is being erected by the British American Oil Co. Ltd. with an initial capacity for crude oil of around 5,500 barrels daily. The McColl-Frontenac Company is expected to start construction on a third major refinery in this neighborhood very shortly.

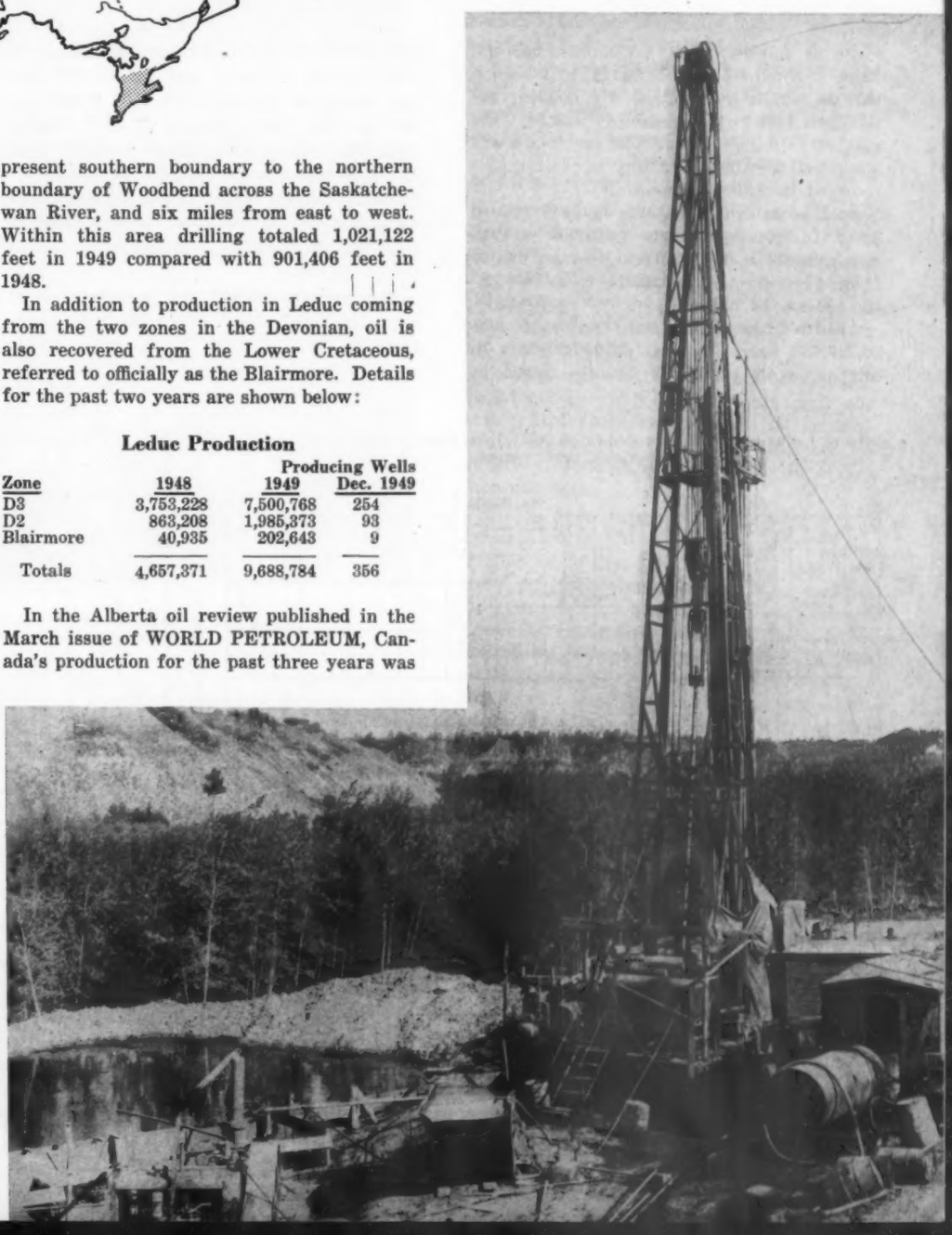
Leduc's productive area now covers about 60 square miles extending ten miles from the present southern boundary to the northern boundary of Woodbend across the Saskatchewan River, and six miles from east to west. Within this area drilling totaled 1,021,122 feet in 1949 compared with 901,406 feet in 1948.

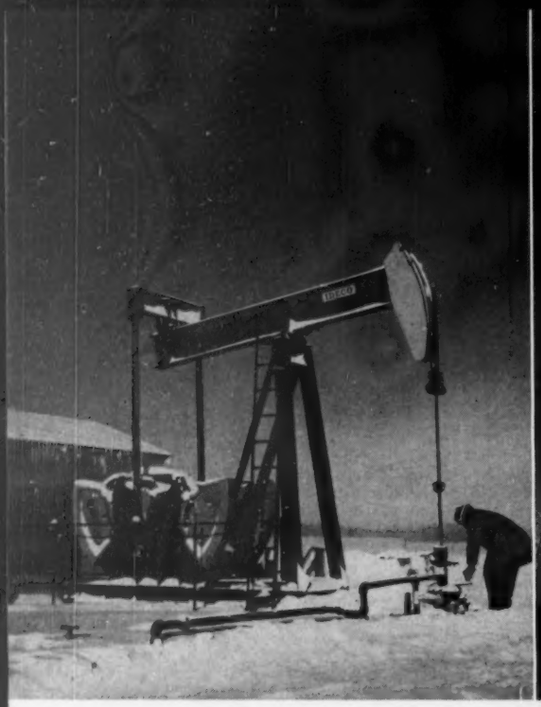
In addition to production in Leduc coming from the two zones in the Devonian, oil is also recovered from the Lower Cretaceous, referred to officially as the Blairmore. Details for the past two years are shown below:

Leduc Production

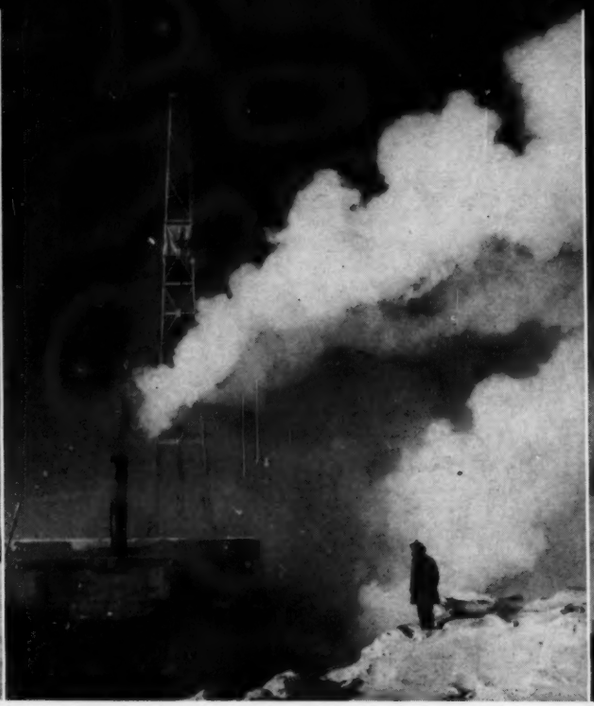
Zone	1948	1949	Producing Wells Dec. 1949
D3	3,753,228	7,500,768	254
D2	863,208	1,985,373	93
Blairmore	40,935	202,643	9
Totals	4,657,371	9,688,784	356

In the Alberta oil review published in the March issue of WORLD PETROLEUM, Canada's production for the past three years was





Imperial pumping well at Bon Accord, near Edmonton.



A cold morning at Imperial's Excelsior wildcat brought in as a producer in 1949.

Discovery well in the Golden Spike field being brought in by burning off contaminated oil.

given as follows: 1947, 7.7 million barrels; 1948, 12.3 million barrels; 1949, 22.1 million barrels. Last year practically doubled the total of 1948. As previously stated, "the gain of 15 million in the past two years was due practically in its entirety to the increase recorded in Alberta province."

Footage drilled in Alberta in 1949 totaled 3,212,616 to compare with 1,663,607 in 1948 and 882,358 in 1947. Total footage drilled from 1914 to 1949 inclusive came to 12,166,390 (2,296 miles).

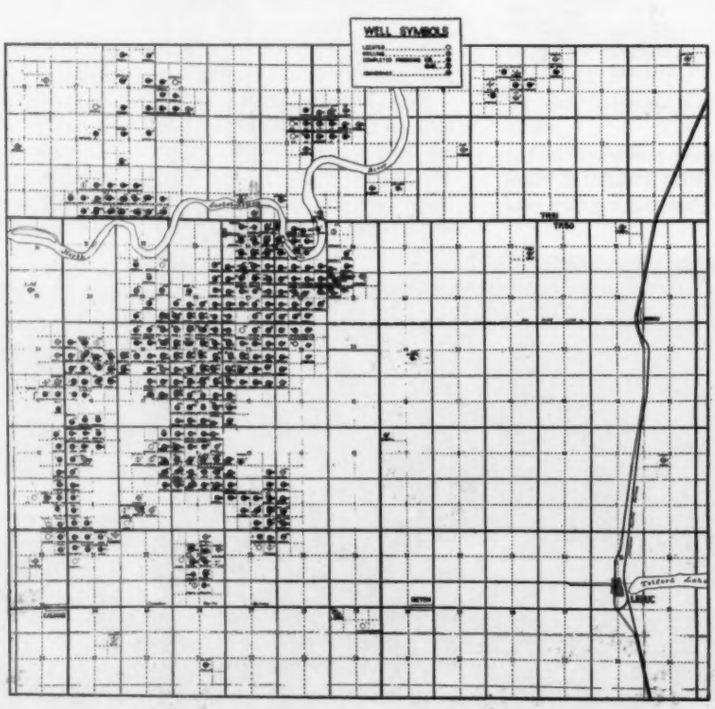
Alberta's production total for 1949 was 20,246,466 barrels valued at $57,999,936 to compare with 10,973,583 barrels valued at $35,127,751 in 1948. Production total from 1914 to 1949 inclusive was 128,354,723 barrels valued at $262,895,079. Oil production for the first three months of 1950 totalled 6,013,985 barrels with valuation of $18,332,437 to compare with 1949's first quarter at 4,283,227 barrels valued at $11,565,805. Gross value per day in the first three months of 1950 rose from $178,418 in January to $225,568 in March.

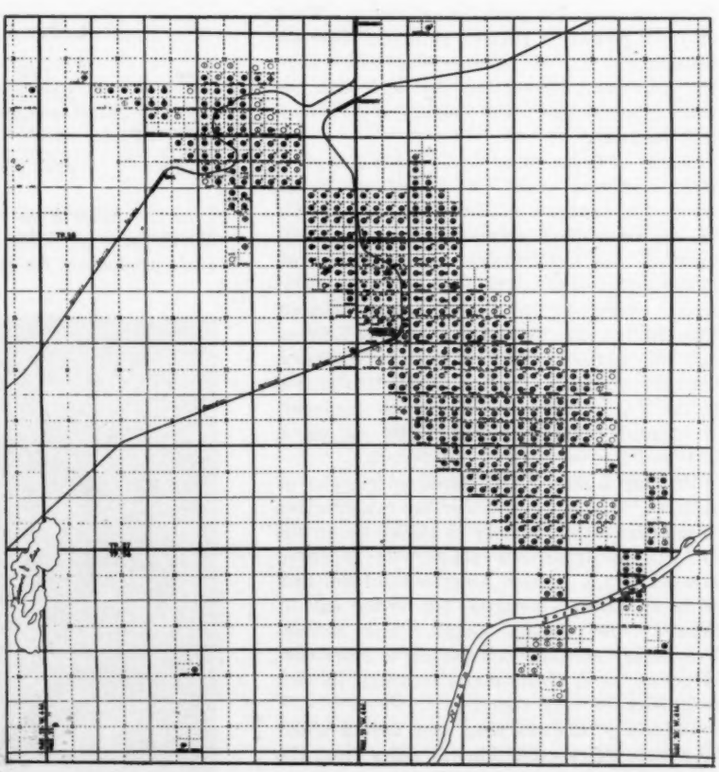
The present market for Alberta's oil is confined to the prairie provinces and ranges from 60,000 to 65,000 barrels daily. This more or less local market, which must continue until the pipeline reaches the lakehead by the end of the current year, is subject, however, to considerable fluctuation.

With the great increase in numbers of producing wells over the past 12 months, together with the impossibility of an extended market at present, it is obvious that the percentage of production quotas allowed must be reduced from time to time. There appear to be exceptions to this, however.

During the latter part of the winter there was a considerable increase in western demand for fuel oil which eased the situation for the time being. This resulted in a climb from the usual 60,000 to 65,000 barrels daily

Map of Leduc field, left, and Redwater field, right, courtesy Alberta provincial government.





until the peak was reached in the week ending March 20, when daily production rose to 79,727 barrels daily. By May 8, however, it had dropped back again to 60,926 barrels.

It is not likely that it will stay long at this bottom figure. Increased demand from industrial, agricultural or domestic sources will come again for long or short periods guided by existing conditions. By the close of the year the pipeline to Superior, Wisconsin, is expected to be ready. This will create new and immediate demand. The line will have to be filled, and that will take around 1,800,000 barrels. Storage capacity at the terminal also calls for a like amount.

The two lake tankers at present under construction are scheduled to be ready for the opening of the next season. Each has a capacity of 115,000 barrels or a total haulage for the two during the season of 10 million barrels. Added to this, the Winnipeg refinery will be opened and calling for 10,000 barrels daily to be transported through the spur line from Gretna, Manitoba. These requirements, added to the prairie provinces' demands, no doubt increased due to greater population and more intensive industrialization, will all contribute to a very different picture for Alberta in 1951.

Redwater is a sequel to Leduc. It appeared on the scene in October 1948 with oil recovery from the D3 zone of the limestone. It produces a 35° gravity crude recovered from depths around 3,200 feet with open flow generally from 1,200 to 1,500 barrels daily.

Diesel-driven pump (right) supplying water through a two-mile line to a Denton & Spencer well near Lac La Biche. Below is pictured the rig which collapsed during a blow-out. A limestone cavern was penetrated causing mud to drop out of the borehole. The mishap occurred in extreme cold weather which caused the blowout preventer jack to freeze. Caterpillar Tractor photos.

Horse-drawn sleds are used by farmers in the Leduc area to traverse snow-choked roads. Photo by Corsini for Standard Oil Co. (N.J.)

The new field is 26 miles to the northeast of Edmonton on the north side of the Saskatchewan River. Starting practically from scratch at the beginning of 1949, it finished the year with a total of 271 wells and a production total of 4,793,491 barrels, which was a spectacular beginning. The Conservation Board's weekly report dated May 8, 1950, gives Redwater a total of 403 producers, the highest of any field in Alberta or Canada. Leduc comes second with 401, Turner Valley, 328, Lloydminster, 136, and other fields, 169. This gives the province a total as at this date of 1,437 producing oil wells.

Early in October 1949, when the field was just one year old, Redwater produced another surprise. It was at this time that Imperial Oil Ltd. had decided to test the area on the south side of the river in the Simmons section. Imperial Simmons No. 1 well was drilled and proved a success in all respects. The water line corresponded with that of Redwater on the north side. The new well had at least 170 feet of productive zone in the D3 and produced the same gravity oil in similar volume to the wells of the north.

Prior to this discovery, the older portion of the field was given a minimum proved reserve of 360 million barrels. Following the southern discovery across the river, another 100 million barrels has been added to the former figure.

Redwater has now taken first place among the productive oil areas of Canada. It is too early really to speak of its size until the southern extension is properly tested. The proven area of the field at present is about 13 miles in length from north to south and four in width.

Development of this field undoubtedly will be intensive. Keen interest attaches to the area south of the river, both as to the number of successful completions—there are six at present—and as to the direction the proven area may take.

Golden Spike, about 18 miles west of Edmonton, brought in its first well early in 1949. Production is from the Devonian, and three wells drilled by Imperial have been successfully completed. Nos. 1 and 4 each have a porosity of 550 feet in the D3, the thickest productive zone of any wells in Canada. The No. 5 well even improved on the performance of the two previous successes by getting excellent production in both the D2 and D3. The D2 zone in the others had proved to be too tight.

No. 5 also established a new record regarding thickness of productive zones in the D3 which measured 560 feet. Open flow of these wells is as high as 12,000 barrels daily. Development is continuing. No. 6, located three-fourths of a mile to the southwest of No. 1, proved a failure; No. 9, a half mile to the north of No. 5, is now drilling. It is possible that the area containing these wells with such pronounced capacity may be limited.

Excelsior is 12 miles to the north of Edmonton. The field was discovered by Imperial last November. There are now seven producers, the last one, Metro Excelsior No. 1, extending the field a mile to the north. Pro-

Oil recovery sand at MacMurray, Alberta, where experiments have been in progress to determine methods of separating oil from the Athabasca tar sands. These represent a tremendous potential reserve for the future. Collier photo for Standard Oil Co. (N. J.)

duction is obtained from the D2, and development is very active there.

The Stettler field, about 100 miles south of Edmonton, is regarded now as a major oil field by its discoverer, Canadian Gulf Oil Co. Its reserve so far has been estimated at 100 to 150 million barrels. Like Leduc, it is capable of production from the D2, D3 and Lower Cretaceous.

An important extension of the field took place some months ago when British Empire Oil Developments Ltd. brought in its first well some three miles to the north of the Gulf development. A 30-foot pay zone in the D2 gave an open flow of around 800 barrels daily. The D3 was too low for production. British Empire's second well doubled the thickness of its first well's D2 pay zone. This second well at the time of writing is being cored at 5,420 feet as a test of D3 possibilities. The score for the present at Stettler is seven completions from Gulf with two more testing, and two completions from British Empire.

Normandville, 30 miles south of Peace River and some 220 miles northwest of Edmonton, has one producer, drilled by Imperial, which came in last October at 7,424 feet in the D2. This success has not yet been followed by development drilling, but tests have been drilled over a wide area to determine structural conditions.

The Campbell field, 12 miles to the northwest of Edmonton, has attracted notice resulting from the No. 4 well, drilled by Redwater Leaseholds. The previous three completions of Redwater Leaseholds in this new field were relatively small producers from the Lower Cretaceous with production from 35 to 50 barrels a day.

No. 4, however, flowed 200 barrels of oil on a four-hour run, making an open flow potential of 1,200 barrels a day. This recovery comes from a lower section of the Lower Cretaceous than the other three wells, and it is thought that this zone may also extend below the present producing zone of the others. Test at No. 4 was taken at the interval of 3,758 to 3,769 feet. Gas was at the rate of 400,000 cubic feet a day. Further active development will be carried out in this field and No. 5 is now drilling.

In the south of the province close to the international border, the Spring Coulee area in the vicinity of Del Bonita has broken into the news with its Coulee Malmburg No. 1 well drilled by National Petroleum Corp., Ltd. Following acid treatments in the Madison lime, the tests have given production around 240 barrels a day.

A full test of potential production has been delayed by the road ban during spring thaw. The well has been drilled to 5,959 feet. The oil is reported to be a sweet, green crude, gravity 38 to 40°. Considerable interest has been taken in this announcement and in the active development program that continues under way by this company.

The Lloydminster field on the Alberta-Saskatchewan border 170 miles east of Edmonton was subjected to severe restrictions in its production in 1949 due to limitations of market. At times wells were allowed 28 to 30 percent of normal production quotas. With development of the area continuing, a great many of the producers were closed down awaiting betterment in market conditions.

Production totals for the whole field on both sides of the interprovincial border were practically equal for 1948 and 1949. The total for 1949 was 1,499,129 barrels as compared with 1,497,221 for 1948. Number of wells producing totaled 181 to compare with 155 for 1948. Under conditions as they existed last year, this gives anything but a clear picture. The numbers of wells shown in this statement refer only to the producers not closed down. Under normal circumstances the total number of producing wells and total production from same would have shown a considerable increase in 1949.

The cumulative production total of the field to the end of 1949 was 4,110,948 barrels. practically all of which has been recovered in the past four years.

Lloydminster has two refineries, the Husky and Excelsior. The former has a fuel oil capacity of 6,500 barrels daily, and the latter of 3,500 barrels daily. Brighter prospects are seen for the area by the Lloydminster Petroleum Association during the current year. A valuable byproduct from the field's heavy black oil is its asphalt which is of excellent quality. This has been particularly demonstrated lately, and sales are expected to be heavy in 1950.

The local refineries are continually developing new uses for this oil, which is expected to reach additional markets during the present year. The marketing situation began to improve in the first quarter of 1950. A large demand for Lloydminster oil is expecfed during the present year due to the conversion by the railways from coal to oil-burning locomotives.

Another important new market has appeared in the conversion by the Saskatchewan Power Commission of their power plants in that province from coal to oil. Briquetting of western coals with Lloydminster oil is still another demand. Markets will be broadened also as a result of the Lloydminster Petroleum Association's success in having the sales tax removed from fuel oil.

The Lloydminster field is now described as the largest "black oil" field on the North American continent. It extends eight miles north of the town, 36 miles south, 12 miles west and 30 miles east. Production is more or less evenly divided between the two provinces. Saskatchewan at present holds a slight lead over Alberta.

In addition to the fields already reviewed, there are 15 others in Alberta of varying sizes. These produced in 1949 630,189 barrels to compare with 730,543 in 1948. The four largest of these in 1949 were Taber with 150,746 barrels, Conrad with 139,728, Princess with 121,227 and Vermilion with 86,933. The first three are about 80 miles to the east and southeast of Calgary. Vermilion is about 40 miles west of Lloydminster.

Oil production in other parts of Canada showed small changes in 1949 compared with the previous year. New Brunswick remained about the same; Ontario gave an increase of around 100,000 barrels; Saskatchewan remained unchanged, and the Northwest Territories dropped around 150,000 barrels.

The total for all Canada last year (preliminary figures) was 21,513,254 barrels to compare with 1948's total (final figures) of 12,371,651, an increase of 9,141,603, which was almost entirely provided by Alberta which produced about 95 percent of Canada's total in 1949.

During the past three years many of the major oil companies, such as Royalite, Home, Anglo-Canadian, Federated, Foothills, Pacific Petroleums and Continental of Canada, were engaged in drilling programs that were most active in Leduc, Redwater and Turner Valley. For this reason these companies were largely responsible for the many successful completions which materialized and which helped so greatly in the upward surge in production totals.

The value of this major progress in oil development to Canada's economy is easy to realize. Reduction of imported oil as a result of these increased figures means a very considerable saving in United States dollars. It means other things as well, such as the real growth at last of a great industry. Industrial and domestic demands for the byproducts of oil are continually on the increase. It begins to look as if Alberta will be able to meet them as they appear.

Discovery well in the Redwater field. Imperial Oil Ltd., photo.

Economic Aspects Of Canadian Oil Expansion

By JOHN F. FAIRLIE*

DISCOVERY of new oil reserves in western Canada early in 1947 set in motion a chain reaction of fundamental importance to the oil industry and to the economic life of the country. To appreciate its significance, it is necessary to recognize the importance of oil to the Canadian economy and the relation of these recent discoveries to the national requirements.

Canada is a country of 13,500,000 who are spread over an area larger than the United States. The major part of this population is distributed in a narrow belt not much more than a hundred miles wide and paralleling the United States border. Although the population belt is narrow, the economy is broad and deep, reaching from the border far into the Arctic. Not only is Canada's economy deep but her military defences are also in depth with the farthest outposts along the Arctic Ocean. The oil industry has a large task in making petroleum products available over the length and breadth of this area and in meeting the rigorous specifications which are imposed by the country's wide seasonal variations.

Canada's wealth is derived from agriculture, manufacturing, forestry, mining and fishing and in each of these industries oil is an important factor. Canada in 1949 used roughly 320,000 barrels per day or 300 Imperial gallons (360 W.G.) per capita per year. This compares with roughly 500 Imperial gallons (600 W.G.) in the United States and 85 Imperial gallons (100 W.G.) in the British Isles. Oil provided the power for 2,500,000 vehicles and tractors; it provided the fuel for a power burner or a space heater in one of every six homes. In addition, large amounts were used for diesel and oil burning locomotives and in shipping.

Table 1

Motor Vehicle Registrations 1935 - 1950

	Cars	Trucks	Buses	Total Motor Vehicles
1935	989,744	172,775	1,848	1,164,367
1940	1,234,637	247,634	2,916	1,485,187
1945	1,160,058	314,327	5,282	1,479,667
1950 (est'd)	1,705,000	540,000	9,675	2,254,675

In the past ten years, gasoline demand in Canada has been doubled by higher car registrations, increased driving and prosperity. Heating oil demand has increased three and a half times in the same period. From 1945 to 1949, consumption of petroleum in Canada has increased 66 percent as compared with 19 percent in the United States.

Two words most graphically describe the problems of the Canadian oil industry and give the key to its development; they are "regional" and "seasonal." Their impact is felt in every phase of operations—in production, transportation, refining and product specifications. By referring to Plate 2 which shows the method of petroleum supply to Canada in 1949, these two characteristics can be quickly appreciated. Canada is a large country and it is not a homogenous area; people, geography, climate and economic development combine to force its division into four regional economies. Each of these has distinct characteristics and each poses a specific problem to the oil industry for supply, for relative product requirements and for specifications.

Refining in Canada is protected by a duty of one cent per Imperial gallon (.83c per W.G.) on gasoline and refined oil and ⅓ cent per Imperial gallon (.28c per W.G.) on other fuels. This protection is necessary because of the relatively small refining units whose small throughputs involve high costs per gallon.

In the East, an economy dependent largely on fishing, ship building and forestry products is supplied by a refinery at Halifax, supplemented by product imports from Gulf, Caribbean and Montreal refineries. Transportation is not seasonal because ports are open the entire year.

The Quebec economy is dependent on forestry products, mining and manufacturing and the population is predominantly French speaking. The largest concentration of oil refining capacity in Canada is located at Montreal with roughly 140,000 barrels per day or almost half the entire industry. Venezuelan and Middle East crudes move in by pipe line from Portland, Maine, and directly by tanker in the summer. These movements are supplemented by product imports which are largely stove oil and furnace fuel oil. Following the war, refining capacity at Montreal was greatly increased and some capacity was installed on the assumption that supplies from this source would move into the Prairies. This is an excellent illustration of the inherent unpredictability of the oil business because, with the recent Prairie development, such a movement is no longer necessary nor will it shortly be economically feasible.

Ontario is a manufacturing province supplied from Montreal and by refineries at Sarnia and near Toronto. The Sarnia refinery has 50,000 barrels per day of capacity and is supplied by a pipe line from the Mid-continent and Illinois fields. Toronto has smaller refineries supplied mainly with crude imported by tanker from Toledo, Ohio.

The economic distribution of products within the Ontario/Quebec region depends on a system of marine terminals which permits utilizing lake tankers on the Great Lakes system and minimizes high cost rail transportation.

The Prairies are mainly dependent on agriculture. Prior to the discovery of the Leduc field, the area was costly to supply, being dependent on imported crude and products for the major share of requirements. Roughly two-thirds of the requirements were met from crude run in a network of small refineries ranging from 300 to 10,000 barrels per day capacity; half the crude came from the Turner Valley field in Alberta and the other half was imported by tank car from Montana and the Mid-continent fields. The remaining third of requirements was supplied in product form through the lakehead from Ontario refineries.

The transportation by rail of Mid-continent crude to Regina cost roughly $2.50 a barrel and so the crude laid down at over $5.00. The cost of moving products from Fort William to Winnipeg is approximately $2.00 a barrel. Moving a barrel of products from Sarnia to Winnipeg, or a barrel of U. S. crude to Regina, costs over twice as much as it does to move a barrel of crude from the Persian Gulf via the Suez Canal to New York, a distance of more than 8,000 miles. The Rocky Mountains in the west are an even more

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He joined Imperial Oil Limited in 1935, and after experience at Montreal refinery, was transferred to Sarnia refinery where he was engaged in engineering development work. He served overseas as an artillery officer, and on being discharged, spent two years in New York with the coordination and economics department of Standard Oil Co. (N. J.) Returning to Imperial, he was made assistant manager of the co-ordination and economics department and in 1949 was appointed manager.

* Manager Coordination and Economics Department, Imperial Oil Ltd.

CANADIAN INDUSTRY SITUATION - 1949 - MB/D

	WEST COAST	PRAIRIES	ONTARIO-QUEBEC	MARITIMES	CANADA
DEMAND	37.5	67.6	181.4	31.0	317.5
RUNS	19.5	57.6	167.3	19.8	264.2
IMPORTS	35.0	3.0	194.3	27.9	260.2
NET TRANSFERS	3.0	9.4	(15.5)	3.1	—

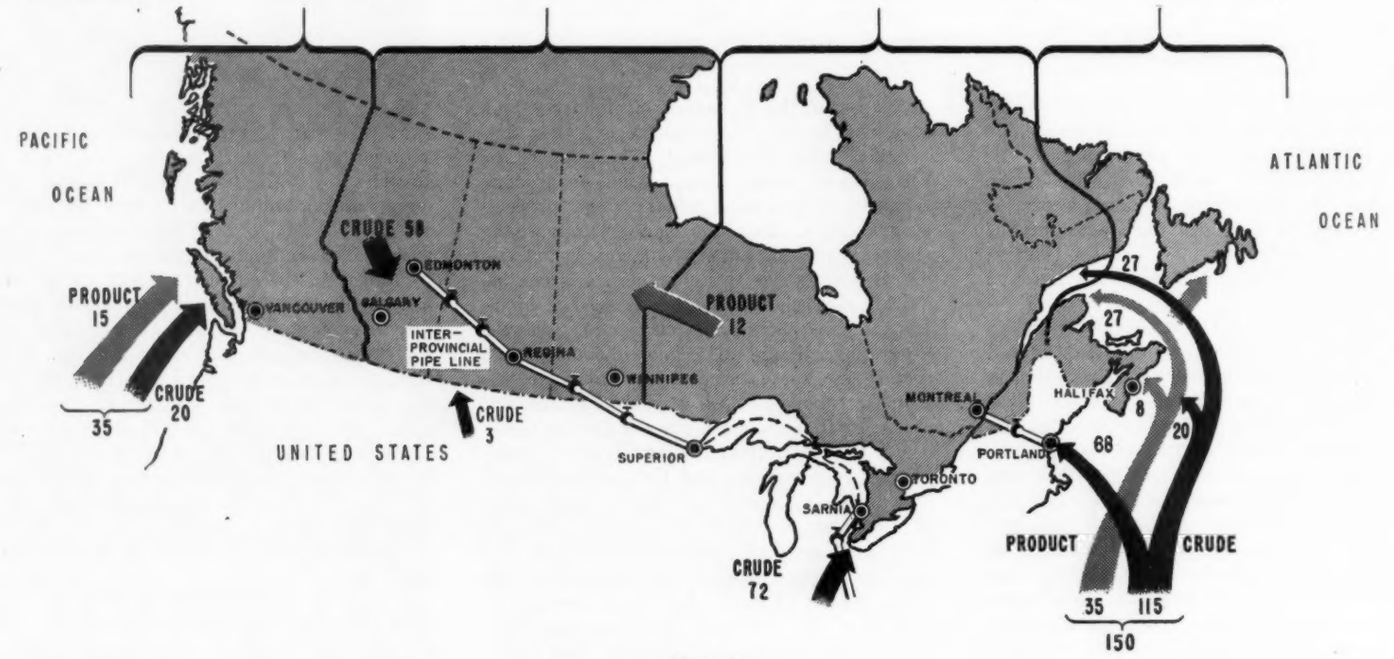


Plate 2

effective barrier to movements from the Pacific seaboard.

With this background, the importance to the Prairies of passing from deficiency to surplus can be appreciated. With the material increase in western crude production in 1949, net imports to the area were reduced to 12,000 barrels a day and in 1950 the position is further improved.

The British Columbia economy depends largely on fishing, mining and forestry products; industrial activity is centered in Vancouver. Refinery capacity is relatively small and both crude and products are imported from California.

From a review of the Canadian economy and the method of supplying it with petroleum, several facts emerge which have a bearing on the disposal of Alberta crude.

(1) Sixty percent of the population and sixty percent of the petroleum requirements of Canada are in Ontario and Quebec, roughly 2,000 miles east of Edmonton, the center of the current oil activity.
(2) The Rocky Mountains are an effective barrier against rail movements to the Pacific seaboard. The Canadian west coast market is too small to be economically supplied by pipe line.
(3) The Great Lakes are an integral part of the transportation system in Ontario and Quebec. Because their harbors freeze in the winter time, a seasonal factor is introduced for both crude and product movements by water transportation.
(4) Alberta oil, because of its remoteness, must be transported by pipe line in substantial volume and as economically as possible to permit it to compete outside the Prairie area with the established oil supply lines. Rail movements are too expensive to offer a solution.

With oil peculiarly suited to the solution of so many of Canada's fundamental problems—those of transportation over its vast distances, of agriculture, manufacturing, mining and feeding the pioneer developments of the north—it is of the greatest importance that Canada should have not only adequate but cheap supplies. There could be no more important development for the Canadian economy than the finding within its borders of an important source of crude which would make oil available cheaply in a country dependent on this type of energy.

The importance of such a discovery is made greater because of Canada's U. S.-dollar problem. Practically all oil imports are paid for in U. S. dollars and to the extent that these imports can be reduced by Canadian production the balance of payment position can be improved. Such a development would not mean a curtailment of trade with the United States but merely a diversion of available U. S. dollar resources to other needs.

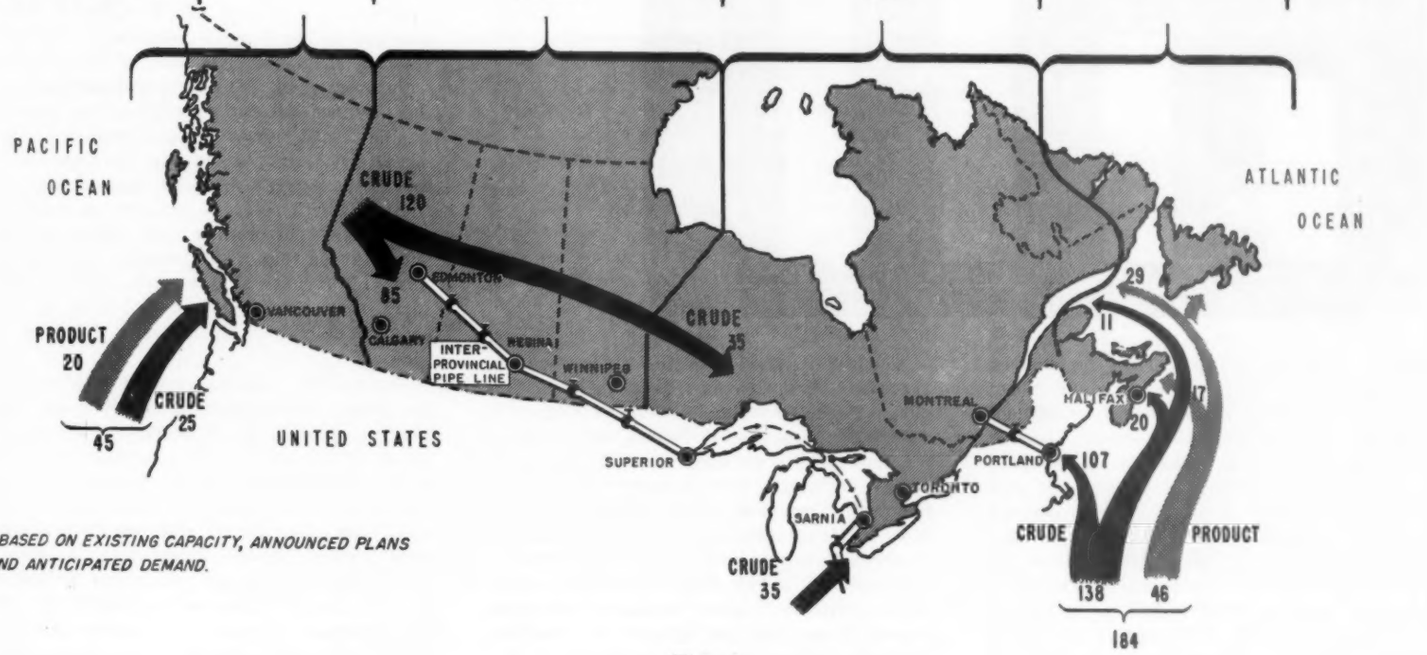
At the time of the Leduc discovery more than 90 percent of Canada's petroleum requirements were imported from the United States and the Caribbean area. Exploration had been carried out over a long period in Alberta but, aside from a few small distillate wells and some wet gas production, no success was experienced until 1936 when an important crude discovery was made in Turner Valley. This production was obtained from the Madison lime in the foothills of Alberta.

The Turner Valley field developed rapidly to a peak of about 30,000 barrels per day but unfortunately its ultimate recovery had been affected by the loss of gas over a period of years. By 1947 Turner Valley had shrunk to between 12,000 and 14,000 barrels per day production and its remaining reserves were estimated at 25,000,000 barrels.

In February, 1947, after having drilled 133 wildcat wells over a period of 30 years and after spending some $23,000,000 Imperial Oil Limited made the Leduc discovery some 20 miles southwest of the city of Edmonton. This field proved to have reserves of 250,000,000 barrels and was one of the world's major discoveries in 1947. It was followed in 1948 by Redwater whose reserves have been raised to roughly 500,000,000 barrels by a recent extension known as the Simmons well. In 1949 additional major discoveries were made at Golden Spike and Stettler. Numerous other small fields have been found which are overshadowed by the major discoveries but they are still important, not only for their production but for the promise which they give of the future potential for the area.

CANADIAN INDUSTRY SITUATION - 1952 - MB/D*

	WEST COAST	PRAIRIES	ONTARIO-QUEBEC	MARITIMES	CANADA
DEMAND	44.9	84.8	217.4	36.5	383.6
RUNS	24.6	84.8	188.3	19.8	317.5
IMPORTS	44.9	--	182.4	36.5	263.8
NET TRANSFERS	--	(35.0)	35.0	--	--



*BASED ON EXISTING CAPACITY, ANNOUNCED PLANS AND ANTICIPATED DEMAND.

Plate 4

The Normandville discovery, around which much activity is now concentrated, is some 250 miles northwest of Edmonton.

These various discoveries have increased Prairie oil reserves in the space of three years from 44,000,000 to between one billion and 1,200 million barrels with the promise that the vast sedimentary area may ultimately prove to have reserves of five billion or more barrels.

"Years of Supply," a concept frequently used, is determined by dividing a country's reserves by its annual requirements. Canada, three years after the discovery of Leduc, finds itself with approximately nine years of supply as compared with 13½ years in the United States. How this extraordinary growth was achieved can be best appreciated from the following table:

Table 2

Canadian Prairie Oil Development

	1946	1947	1948	1949
Under Reservation[1] —MM Acres	20	30	56	115
Geophysical Parties	11	23	59	105
Exploration and Development Cost[2] —MM $	12	25	50	100
Oil Wells Completed	59	196	249	580
Reserves[1] —MM Bbls.	44	151	458	1,000
Production Potential[1] —MB/D	19	24	40	117

[1] Year End.
[2] Estimated 1950 $150 Millions.

The present potential production at MER is estimated to be 135,000 barrels per day, or roughly 40 percent of Canada's total petroleum requirement. However, this production cannot yet be marketed because of high rail transportation costs. It is to reduce these costs that a 1,150-mile pipe line is being built from Edmonton to Superior at the lakehead.

There are currently 112 geophysical parties in the field and the Canadian west is the second most actively prospected area in the world, surpassed only by Texas. Approximately 300 Canadian and U. S. companies are taking part in the oil play and among them are the major oil companies of the world. These companies are operating under Alberta government rules which have had an important bearing on the degree of urgency in developing new markets for production. In Alberta, unlike most provinces and states, 93 percent of the mineral rights belong to the government. In order to encourage exploration the provincial government adopted a policy some years ago of granting government reservations to exploring companies. At present the province will issue up to two 100,000-acre reservations to each exploring unit or individual. These reservations may be retained for three years without converting to leases, providing the company meets certain work obligations involving geophysical surveys, core and development drilling. In the first year a nominal fee and deposit is required, in the second year a fixed rental is charged and in the third year the rental is increased and drilling is compulsory.

If a discovery is made on government acreage, the discoverer must within three months make a selection of leases and return half the acreage to the province. The acreage retained must conform to certain rules which, for instance, provide that a solid lease block cannot be larger than nine square miles and that a one-mile corridor must be left between lease blocks. The acreage which reverts to the province may, if the government sees fit, be put up for auction by sealed bids. The purchaser of these auctioned lands is required to carry out drilling operations within one year. The effect of these rules is to make potential production snowball—the process is largely automatic. Some companies farm out some of their prospects to other organizations because of the size of the financial and physical demands. At the present time each successful well reduces what can be taken from the remaining wells and this will continue until adequate markets outside the Prairies can be economically reached. Yet so long as each lease holder stands to lose his lease if he fails to drill, he must go on drilling even if he is adding to potential production which cannot yet be moved to market.

It is the self-generating nature of these regulations and the fact that no outlet exists at present except within the Prairies that imposes a strain on the oil operator and makes the quick provision of pipe line facilities so vital.

It became evident as Leduc was delineated and with a subsequent discovery at Redwater that sufficient crude existed to warrant ex-

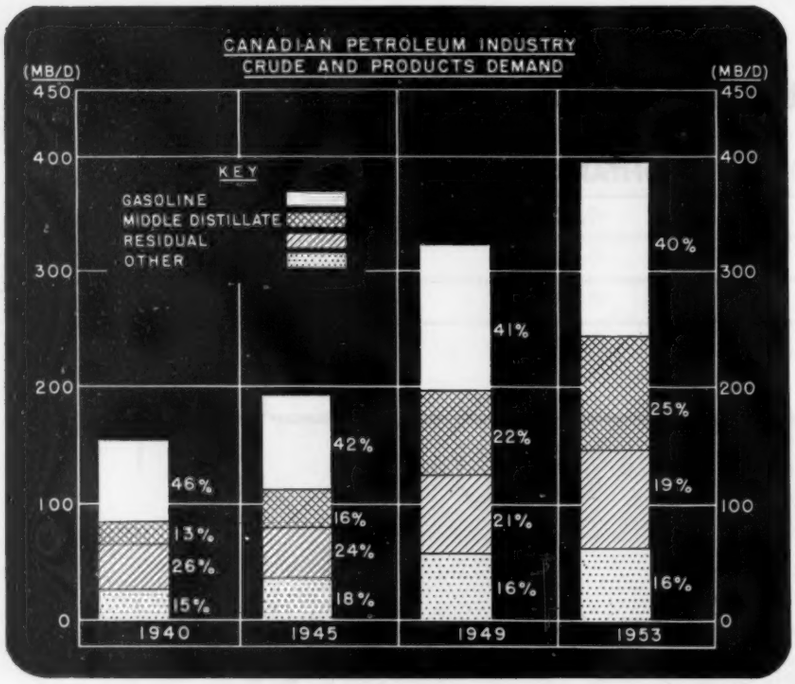


Plate 1

porting it from the Prairie area—the question was to whom. There was no doubt about the means: a large movement by an efficient pipe line was required to overcome the distance penalty and to make the oil competitive with other sources of supply. A pipe line would cut transportation costs to perhaps one-third of those by rail and place the Canadian producer in a competitive position in relation to other world producers. The problem was where to build it and the need was immediate to draw off production which would otherwise suffocate the industry as fresh resources were proved up and allowables were cut back. No refinery capacity existed either in the United States or in Ontario which could be economically reached by rail and leave any inducement to the producer in the field.

To the west there were the Rocky Mountains, a discouraging obstacle and definitely high-cost pipe line territory. At the end of 800 to 1,000 miles of difficult pipe-lining was the Vancouver market for some 30,000 barrels of light crude. However, its refinery capacity is only roughly two-thirds of this and much of that capacity requires modernization. The movement over the Rockies would be economical only if a large volume of throughput were obtained, something of the order of 60 to 100,000 barrels per day.

To the east a large market existed in Ontario refineries at Sarnia and near Toronto which could use the crude as soon as it was made available. To enter the Ontario markets would require a substantial reduction in the field price but this would be more than compensated by the increased volume of outlet obtained. The decision was therefore made to go east with the pipe line.

In moving east the crude will pass a deficient area in the northern central United States. This area has little refinery capacity at the present time and is supplied by product pipe lines from the Mid-continent and Chicago areas. However, with the economic facts established by a crude pipe line, there may be some inducement to American refiners to establish capacity and make use of the new Canadian crude.

A company known as the Interprovincial Pipe Line Company has been formed. Its purpose is to move crude from the Edmonton area into refineries at Sarnia and Toronto in competition with their existing sources of supply from the Mid-continent and Illinois fields. To compete it is necessary to lay down crude of equal quality at these refining points at the same price as their present supplies. It is the value of crude in this fringe market which will ultimately establish the wellhead price of oil in the Prairies. Since the present price is established on the basis of meeting competition in the various Prairie refining centers, reaching out to this fringe market will require a reduction in the Alberta well price.

The pipe line is to be 1,150 miles long and 20″ in diameter between Edmonton and Regina, 16″ between Regina and Gretna, south of Winnipeg, and 18″ from Gretna to Superior, Wisconsin. Its capacity provides for meeting the crude requirements of the Prairies refineries at interim points and for the delivery of 50,000 barrels per day of crude to the lakehead in the summer time. Storage is being provided at the lakehead to accumulate 1,500,000 barrels of crude in the winter time. This operation will permit supplying only half the existing Ontario capacity. However, by the addition of six pipe line stations, summer deliveries to Superior can be increased to 90,000 barrels per day. Further increases can be obtained by providing additional terminal storage so that the full requirements of the Ontario refineries can be met when sufficient crude reserves are developed.

The large concentration of refinery capacity at Montreal is at present too remote from Prairie production because as the oil moves eastward it comes into increasing competition with the world supplies of the United States Gulf, Venezuela and the Middle East —all of which can be moved by cheap ocean transportation. However, there is nothing static about the situation and at some time in the future construction of the St. Lawrence waterways and the development of much larger resources in the Prairies may make such movement feasible.

The development of important crude production in the Prairies has had a far reaching effect throughout the Canadian economy. Further, it may have important repercussions on the general oil supply lines of the North American continent.

In 1949 the average Prairie production was roughly 58,000 barrels per day. This had a value to the local economy of some $60,000,000, but the implication of future discoveries and the attendant activity had a much greater effect than this on Alberta.

Because 93 percent of the mineral rights belonged to the Province of Alberta, the provincial treasury receives most of the royalties from production. From government acreage, the province currently receives 12½ percent or one barrel in every eight produced. Alternatively, an operator can elect to pay a royalty based on the square root of his production. With reserves in excess of a billion barrels and the promise that additional billions may be found, the province appears assured of a continuing income over the life of the fields running into hundreds of millions of dollars at the present world crude price.

The second important source of wealth to the Alberta government from oil is the sale of leases, that is, the 50 percent of the reservation which an exploring company returns to the government when it makes its selection of acreage. To date some $38,000,000 have been obtained by the Alberta government through the auctioning of lands whose values were developed by the oil industry. Of this, $16,000,000 has been collected this year through the sale of 24 quarter sections of 160 acres each. Seven of the quarter sections were sold at prices ranging from a million to more than $1,600,000 or from $6,200 to $10,000 an acre, indicating that companies are prepared to pay large sums for oil in the ground in lieu of finding it.

Table 3

Oil in Canadian Trade—1949
(Millions of Canadian $)

	With Dollar Countries	With Sterling Countries	Total
Commodity Imports	2,267	494	2,761
Oil Component	275	5	280
% of Imports	12%	1%	10%
Commodity Exports	1,978	1,015	2,993
Net Balance of Payments (Including Invisible Items)	—397	+590	+193

The government and the people of Alberta are sharing substantially and directly in the wealth which is being created. In the current fiscal year, the Alberta government is anticipating $18.8 million, or roughly 25 percent of its total revenue, from oil. This exceeds $20 per capita and is made up of $4,000,000 from fees and rentals, $2,800,000 from royalties and some $12,000,000 from the sale of leases. It is quite possible that this may be materially exceeded through additional auctions of leases.

The province now has a debt amounting to roughly $130,000,000 and it is quite possible that the day may come when oil will have removed this burden. The government is following the principle that oil income is revenue from the depletion of provincial assets and should be used for capital expenditures

and the creation of new provincial assets. These are taking the form of new highways, hospitals, university facilities and conservation projects. The application of this policy is illustrated by the following table—

	Capital Expenditure for Provincial Construction Projects	Millions of Dollars Revenue from Oil Development
1948-1949	16.8	10.3
1949-1950	15.3	25.6
1950-1951 (estimated)	21.3	14.8
	53.4	50.7

The investment which is being made in Alberta is great. In 1949 more than 300 Canadian and United States companies and syndicates spent $100,000,000 or $2,000,000 a week for exploration and development. The momentum is increasing and expenditures in 1950 are expected to be more than $150,000,000 for these operations.

The effect of this money being injected into the Prairie economy has been large—scores of new businesses are being established—new towns are being created. The population of Edmonton has increased from 119,000 to 137,000 since 1947. Its bank clearings had increased 50 percent over 1947 by the end of 1949. Edmonton has a new 16,000 barrel-per-day refinery. Two others are planned by major companies and will involve an investment of $20,000,000. A new refinery is being built at Winnipeg which will cost approximately $10,000,000. Other refineries are being planned throughout the Prairies. This network of new facilities will permit the most economical supply of petroleum to a rapidly growing segment of Canadian industry.

Last year western oil developments permitted a cut of more than $30,000,000 in the oil bills of Prairie consumers, equivalent to an average of $12 per person and representing a price reduction of approximately 3½ cents per gallon below the price which otherwise would have prevailed. With the lower price of crude following completion of the Interprovincial pipe line and with a network of economically located refineries, further price reductions for petroleum products will be possible. These reductions will permit the Canadian farmer who depends on mechanization to compete more successfully in world markets; they will help him to overcome his transportation disadvantage. The availability of cheap petroleum products may also be an invitation to industry to capitalize on low fuel costs and a cheap supply of raw materials for chemical manufacture. The development of oil will go far toward freeing the Prairies from an economy dependent on a single industry.

To Canada the significance of a new industry in the Prairies is great. By 1949, two years after the discovery of Leduc, the value of production had attained $60,000,000 but this permitted a reduction in U. S. dollar requirements of $90,000,000, largely because transportation is to some degree a U. S. dollar requirement. Despite this Canadian contribution the U. S. dollar requirement for petroleum in 1949 was roughly $275,000,000.

At the same time Canada's adverse balance on current account with the United States was approximately $600,000,000. This was reduced an estimated $200,000,000 by receipts from other non-sterling sources to give a net deficit of approximately $400,000,000 with the U. S. dollar area. Roughly 12 percent of Canada's U. S. dollar requirements on merchandise account were for oil.

By 1951 when the Interprovincial Pipe Line is completed the estimated U. S. dollar saving will be roughly $140,000,000 and one-third of Canada's petroleum requirements will be met from Canadian sources. The value of Canada's nickel production was $100,000,000 in 1949 and in the same period gold production was approximately $148,000,000. Four years after the Leduc discovery oil production will be contributing to Canada's wealth and to the solution of the U. S. dollar problem an amount comparable to these long established and important industries. Plate 4 indicates that imports in 1952 based on present pipe line plans will still be required at approximately the present level owing to the growth in demand. However, if production continues to develop at the present rate, these plans undoubtedly will be expanded before that time.

In conjunction with the iron ore of Labrador and the more intensive development of the forestry and manufacturing industries, a solution to Canada's exchange problem may be expected in the not too distant future.

Producing operations in the Prairies are also contributing indirectly to the Canadian economy. Two factors are among the chief determinants of the level of prosperity; one is the level of exports and the other is the volume of capital expenditures. In 1949 private capital expenditures in Canada were at an all-time high, at an estimated level of $3 billions or 18 percent of the gross national expenditure. Of this, capital expenditures resulting directly or indirectly from western crude developments made up a significant part in such items as Prairie refinery capacity, pipe manufacturing equipment, the erection of a $5,500,000 gasoline plant at Leduc and the $100,000,000 or more expended in exploration and development. In 1950 the contribution to a high level of capital expenditures will be even greater. The indirect contribution through induced expansion in other industries and business generally is difficult to measure, but it is certain to be large. However, the directly related expenditures can be easily visualized: $90,000,000 for the Interprovincial pipe line, $8,000,000 for two new lake tankers, $30,000,000 for additional Prairie refining capacity and perhaps $150,000,000 for exploration and development. On a conservative basis, it would appear oil expenditures in 1950 may be directly responsible for roughly 10 percent of the total private domestic investment. This is an extraordinary contribution to be made by a single Canadian industry only three years after the discovery of oil at Leduc.

Turning to the continental impact of the Canadian Prairie developments, it is difficult to say what the course of events will be. There are three facts which are generally accepted on which Canadian oil may have some bearing.

The first is that over the long term the United States will be dependent to some degree on outside sources for its petroleum needs.

The second is that the northern central states are a deficit area adjacent to the pipe line movement of Alberta crude.

The third is that California is expected to become dependent on outside sources in the future.

Just how Canadian oil and gas might contribute to two-way trade between Canada and the United States is uncertain at the moment and is a matter for the governments of the two countries to decide.

Lastly, the development of large reserves in the Prairies contributes to the strategic security of North America. With oil supplies available within the continent, transportation is minimized and vulnerability is reduced. Canadian oil reduces the uneconomic measures which must be taken to insure security, such as stock piling or synthesis, which might otherwise be necessary to assure continental supplies of energy. It would seem

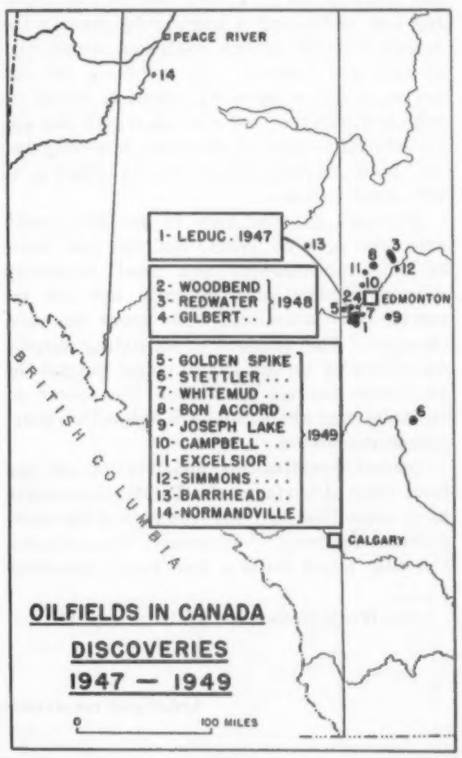


Plate 3

that the peace-time policy of Canada and the United States should be aimed at the building up of reserves within the continent based on the shortest and most efficient supply lines. The development of petroleum reserves in western Canada has added substantially to the security of the continent.

In conclusion, the discovery of Leduc in 1947 has brought into being a new industry at a most critical time in Canadian economic development. Subsequent events indicate that Prairie oil is going to be of the greatest importance to the continental economy. Its discovery does not mean a curtailment of trade with the United States or any other country, but on the other hand it should go some distance toward the loosening of existing restrictions and toward the mutual aim of free convertibility of currencies throughout the world.

Ample Natural Gas Supply For Canadian and U. S. Pacific Coast Markets

RIVALLING in importance the ever-growing expansion of Alberta's oil reserves are those of the province's natural gas. Drilling test wells over a widespread area in the search for oil brings continual discoveries of new gas reserves. In reversing the situation, a gas exploratory program would reveal new reserves for oil. A search for gas to determine size of reserves, however, has not been carried out as yet in Alberta to any great extent.

Alberta's gas has been in use on a small scale for over 60 years, but the real value of this much-needed and most important natural product until recently has not received much attention. The scene has now changed. The question of exporting surplus quantities of natural gas to points beyond the provincial borders has taken the center of the stage and has become the subject of widespread discussion.

Several projects for construction of gas lines from Alberta to the Pacific Coast have been organized and are competing for government approval.* Westcoast Transmission Co. Ltd. would build a line from Edmonton through British Columbia to Jasper and then via Kamloops to Vancouver—an all Canadian route. From Vancouver the line would continue into the United States to the west coast cities.

The North West Natural Gas Co. and the Alberta Natural Gas Co. propose a southern route through the Crowsnest Pass to Cranbook, south over the international border at Kingsgate, and then west to Spokane. At a point between Kingsgate and Spokane a branch is to go north to feed the smelter at Trail, a large prospective consumer. From Spokane the line is to continue to a point north of Seattle where it will divide into two forks, one going north into Vancouver and the other south to Seattle and Portland. Another company, the Alberta Natural Gas Grid, would be formed for the installation of gathering lines throughout the province. This company would sell gas to the export company.

Several other applicants have submitted plans for lines extending to the west coast. One of these is the Interfield Gas Lines Ltd., with which H. R. Milner, K.C., is associated. This company's objective would also be the installation of gathering lines and sale of gas to the lines exporting. Other projected lines are sponsored by Prairie Pipe Lines Co., headed by Glen Wilton of Toronto, Bruce Smith of Edmonton, and a group organized by Lloyd B. Champion of Montreal.

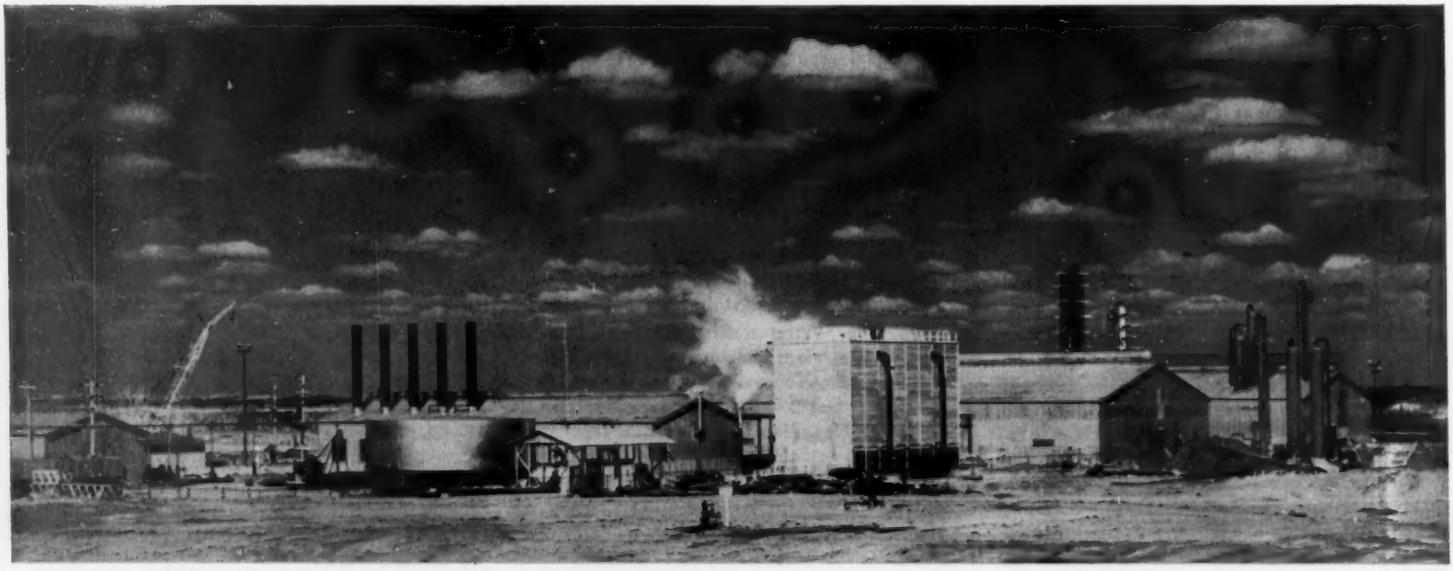
The natural gas hearings to consider applications opened in the Calgary Court House before the Petroleum and Natural Gas Conservation Board on January 30 and continued to April 11, when they were adjourned for the opening of the Legislative Assembly.

The application of the Westcoast Transmission Co. was first considered. Evidence submitted covered in considerable detail every phase of the proposal. The all-important item of the hearing was whether or not Alberta's natural gas reserves were adequate for domestic consumption over a reasonable period of time. This point took precedence over all others. Failure to establish such adequacy would make all other details irrelevant and permission for export would fail to be given.

On the assumption that adequate reserves existed for both home use over a fifty-year period, allowing for increases in domestic and industrial demands during that time, and for export now to the Pacific coast, the next

* See *World Petroleum*, April 1950, p. 46.

Leduc gas conservation plant at Devon built by Imperial Oil Ltd. at a cost of $5 millions to process gas from the Leduc-Woodbend field.



point for consideration would be one of route.

Consideration of this question would be related to its desirability as far as citizens of Alberta and Canada were concerned, a route that would have their best interests in mind. These interests would include such items as cost of supplies to the consumer, financing ability of the applicant and other matters of this nature.

It was thought advisable that members of the Legislature interested in the hearings should have an opportunity to be present. This was not possible when the House was in session, and for that reason the adjournment was made to April 11. In the course of time the Conservation Board will make its recommendation to the Cabinet, when all hearings have been concluded. Final word in the matter will come from the Cabinet as to granting or rejection of the application.

Evidence regarding the province's natural gas reserves, their extent and accessibility, was given by the following experts: Dr. A. W. Nauss, chief geologist of Pacific Petroleums who has made a province-wide investigation covering producing fields and those likely to produce; Dr. Theo. A. Link, formerly chief geologist for Imperial Oil Ltd. and now in general consulting practice with offices in both Calgary and Toronto; Dr. C. R. Hetherington, chemical engineer for Ford, Bacon and Davis Inc., well known New York engineering firm; Dr. John F. Dodge, formerly evaluation engineer for Standard Oil of California, consulting engineer for the State of California, for the United States government Treasury Department, the United States Navy and United States Department of Justice; and C. R. Sample, expert on the staff of Ford, Bacon and Davis.

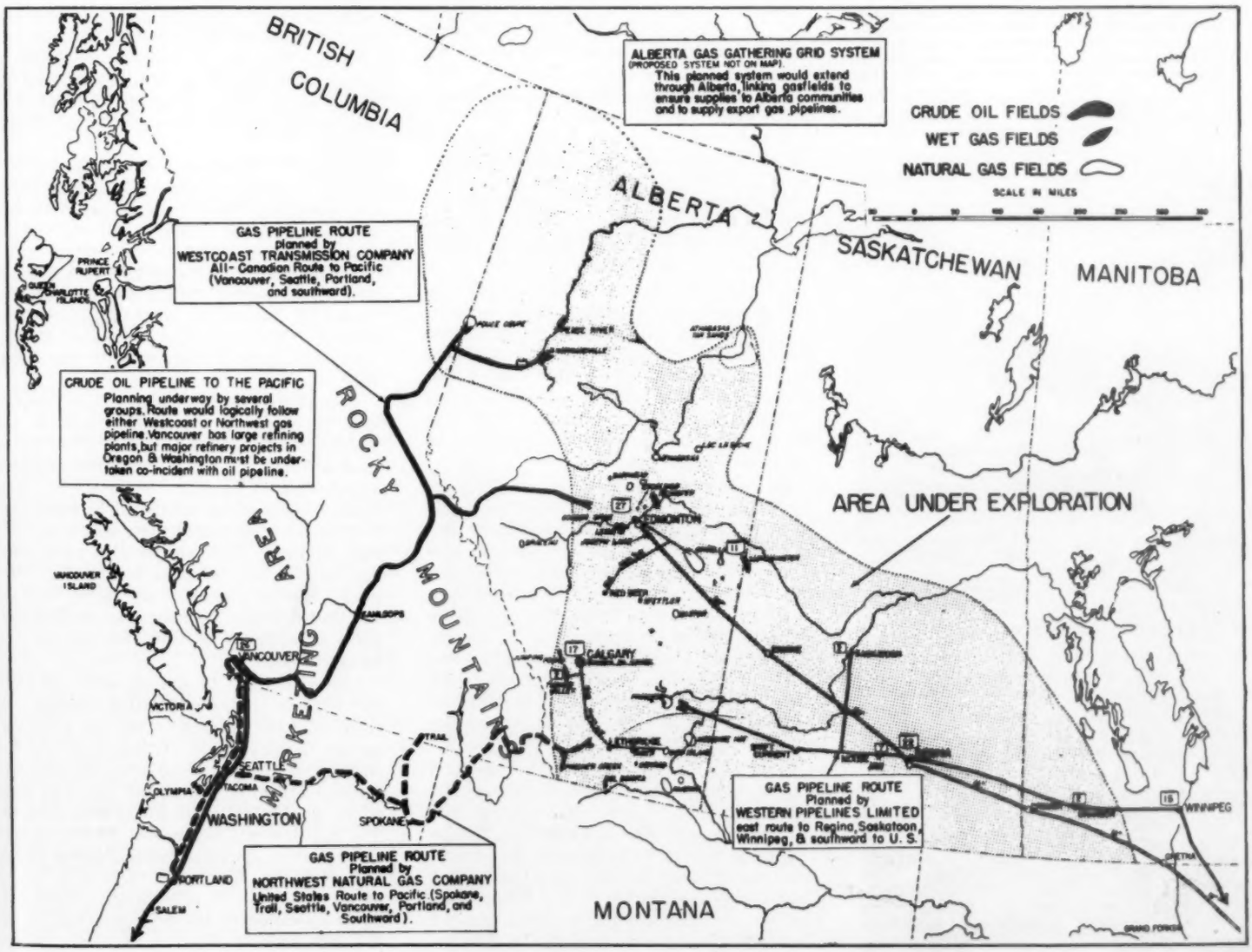
A summary of the conclusions shown by these gentlemen pointed to the fact that 7.503 trillion cubic feet, with 5.947 of this total marketable, stood as the present natural gas reserve of Alberta; and that 3.49 trillion represented the additional amount to be added to the total of 4.26 trillion established early last year by the Dinning Commission.

Consumption of gas in Alberta for the past 36 years—to the end of 1948—totaled only 400 million cubic feet, it was stated. To be added to this total was the wastage of the gas-cap days when Turner Valley operated without the restraining hand of any form of conservation, a period of years in which over a trillion cubic feet of natural gas was burned in flares.

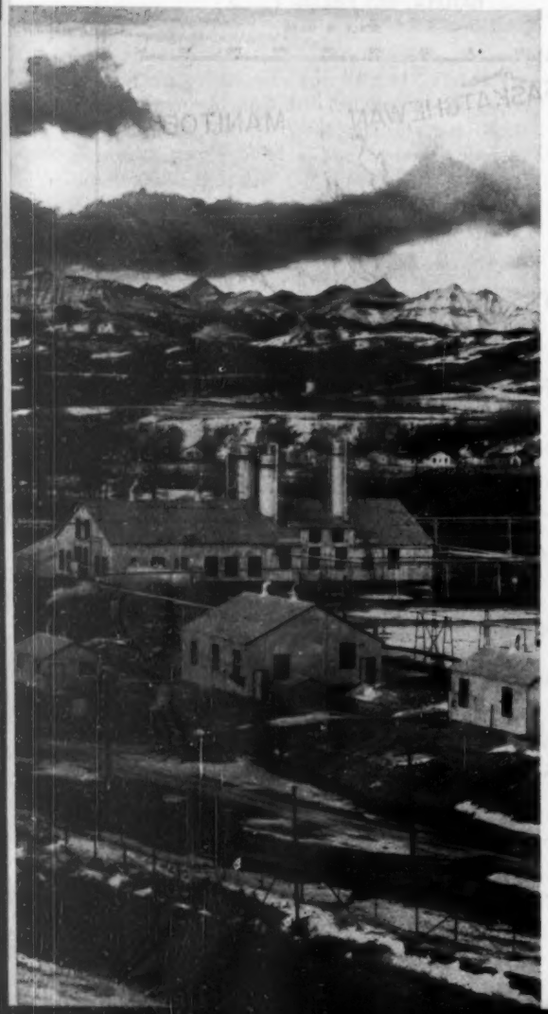
Dr. Nauss stated that only a small fraction of the general area had so far been prospected. That which had, for the most part, had been done by single wells which, in the absence of any market, had been capped or abandoned. In his opinion it was reasonable to predict a potential of at least 50 trillion cubic feet, which might easily reach 100 trillion if unexplored territory in the vast sedimentary basin of the province proved as rich in gas as the relatively small area which has already been tested.

Dr. Link repeated the opinion he gave before the Dinning Commission early in 1949 to the effect that within five year's Alberta's natural gas reserve would be 10 trillion cubic feet. This prediction, he remarked, had been confirmed completely by the increase last year. Half of the 10 trillion cubic feet would satisfy the requirements of the entire Pacific

Map showing routes of proposed gas lines from prairie province fields to Pacific Coast consuming areas to the west and to Winnipeg and northern United States markets to the east. Route of the pipe line proposed by Northwest Natural Gas Co. through Spokane, Wash., is indicated by a broken line while the "All-Canadian" route proposed by Westcoast Transmission Co. from Pouce Coupe and the Edmonton area is shown by a solid line. The Western Pipelines, Ltd., proposal is a line to serve Regina, Brandon, Winnipeg and cities in North Dakota and Minnesota. Not shown is the proposed grid system to various Alberta fields for gathering gas for local distribution and export. Map was prepared and is published through the courtesy of C. O. Nickle Publications, Ltd., Calgary, publishers of the Nickle Map Service.



Discovery well in the Jumping Pound gas field in Alberta drilled in 1944 by Shell Oil Co. of Canada, Ltd. A government commission last year estimated Shell's reserves at Jumping Pound to equal a fifth of the province's known reserves at that time.



Imperial Oil Ltd. absorption plant at Turner Valley. Photo by Corsini for Standard Oil Co. (N.J.)

coast for a period of 30 years. In his opinion Alberta has plenty of gas for export in addition to a liberal home supply.

Dr. Dodge concluded his opinion with the following remarks on the gas situation in Alberta: "You will have gas running out of your ears in this province. You should be more worried about what you will do with it than how much this or that field will produce. Gas is automatically produced with oil, and if your country has the oil future you think it has, an opinion with which the oil world appears to agree, you will have more gas than you will know what to do with."

Speaking of the reserves of Jumping Pound and Pincher Creek, he gave as a result of his studies of these two fields a total of 895 billion cubic feet for Jumping Pound and 1.48 billion for Pincher Creek. This conclusion was made with the reservation that neither field had been sufficiently developed to reveal the size of area or total productive capacity.

Engineers of Ford, Bacon and Davis, Inc., who have investigated every phase of the question, submitted evidence on other points. They showed that Westcoast's all-Canadian line would serve 2,500,000 people by 1955 in the fastest growing areas on both sides of the International Line, when gas would be delivered at the rate of at least 56 billion cubic feet annually.

C. R. Sample, senior engineer of the firm, stated that British Columbia's population had increased 55.9 percent in 17 years. This was more than twice the average of Canada as a whole. The population of the United States on the other hand between 1940 and 1947 had increased only eight percent. California, Washington and Oregon, representing the only market that would make a pipeline service from Alberta profitable, had, however, increased 40, 42 and 33 percent respectively in the same period.

He made the statement that the area referred to was the only virgin, populous, prospective consuming area left in the United States. In the course of 20 years, on a basis of a carrying rate of 56 billion cubic feet annually, the total delivery would be only 1.2 trillion cubic feet in comparison with estimated deliverable supplies from Alberta of six trillion cubic feet.

He estimated Alberta's gas requirements for the next 50 years at 2.78 trillion cubic feet and remarked that his estimate complied with the stipulation of the Alberta government that Alberta's consumption should be taken care of for the next 50 years before export would be permitted. The compliance had been carried out by allowing for present saturation of domestic and commercial home markets; and for generous increases which embodied calculated population increases and present industrial use with reasonable increases of this use.

Regarding the proposal for piping gas eastward to Winnipeg and points on the way, Mr. Sample stated that provincial fields in the southeast sector, the proven reserves of which at present were 680 billion cubic feet, would take care of that demand. At the present time there is no market in any other direction for such reserves, nor are they required for any existing gas markets in Alberta. Should a line be built to Winnipeg, however, the result might mean high consumer costs due to the absence of a large industrial demand load.

With reference to the feasibility of the all-Canadian projected Westcoast route, several engineers of the same firm gave evidence after they had covered it by motor, plane, horseback and on foot. The engineers in question were George J. Phillips of Monroe, La.; J. E. R. Wood of Vancouver, who had made a special study of the route from Vancouver to Kamloops, and A. F. Kent, who had studied in detail the Kamloops-Edmonton section, the section of the line which is to travel through the Rocky Mountains and Yellowhead Pass.

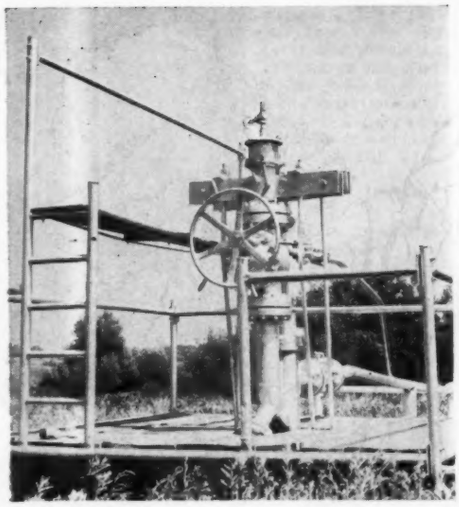
Their evidence was that the general route presented no greater difficulties than were presented by the terrain through which other lines in many parts of the United States had passed. The length of the proposed line will be 1,025 miles, with branch lines 119 miles and gathering lines systems 426 miles, making a total of 1,570 miles as stated by Dr. C. R. Hetherington when testifying on the subject of construction and costs. Total compressor station power will be 2,400 hp in the first year, to be increased to 7,200 in the fifth year.

The main line to the United States border will be 24 inches over a distance of 725 miles, while a 40-mile, 14-inch pipe line will connect Vancouver, Kamloops and Chilliwack. The line into the United States will be 24 inches to Wickersham, Washington, and reduced to 22 inches to reach Portland, Oregon, for a total of 300 miles in the United States.

Points in Washington to be reached will include Bellingham, Seattle, Tacoma, Olympia, Centralia, Everett, Kelso, Longview and Camas. Gathering lines in Alberta will include 150-mile, 16-inch connection with Pincher Creek, 22 miles of 12¾-inch connecting with Jumping Pound, 40 miles of 4½-inch with Stettler, 30 miles of 18-inch from Legal to Edmonton and six miles of 8⅝-inch connecting Picardville with the Legal line.

Cost of the line through the Canadian section is given at $95 million, and in the United States at $19 million. Pipe to be used will total 220,000 tons, 170,000 of which will be laid in Canada. Materials for compressor stations can nearly all be purchased in Canada. The cost of these will amount to $20 million. Purchase of the plate steel for the pipe will be made in Canada. Part of it, however, would have to be sent to the United States for rolling, as no Canadian plant is equipped to turn out pipe of the larger dimensions.

Laying of pipe in Canada will cost over $20 million; coating will cost $2 million. A force of 2,000 Canadians will be employed on the Canadian side. Other costs will include surveying and mapping; regulator stations; dehydration plants, and rights of way, which alone might reach $360,000 in Alberta. The gas flow will be boosted by compressor stations from Jumping Pound, Pincher Creek and Stettler. Eventually there will be 10 on the main line, 75 miles apart. Three will be in operation in the first year and all in the fifth year.



Viking-Kinsella gas well. Alberta Government photo.

During the proceedings a brief was presented on behalf of the British Columbia Electric Company supporting the application. The B. C. Electric supplies power and light to Vancouver and other mainland communities. Should the line go through, it was stated that widespread use of Alberta gas would result for heating and industrial purposes. The B. C. government, represented by the Hon. George Wismer, attorney general of the province, gave its endorsement to the northern route. The project would insure domestic and industrial requirements of British Columbia as the first consideration. Also an opportunity would be afforded for development and expansion of northern Alberta and British Columbia. In that part of B. C., he stated there were 50 million acres of potential gas lands.

The Commission consisted of I. N. McKinnon, chairman; D. P. Goodall, vice chairman; and Dr. G. W. Govier. Many interests were represented by counsel. A further hearing of Westcoast's application opened on April 11 when adjournment was taken until June 12.

On May 12 the Hon. N. E. Tanner, Minister of Mines and Minerals of the Alberta government, officially opened the Leduc Gas Conservation plant. The plant has been constructed by Imperial Oil Ltd. to conserve gas which would otherwise be wasted. Construction was started in June 1949 by C. F. Braun and Co. The total cost of plant and gathering system was in the neighborhood of $5.5 million.

The unit is designed ultimately to process 24 million cubic feet of gas daily. Initial capacity is about 17 million cubic feet, and operations will be at a substantially lower volume pending further field developments and expansion of crude oil markets.

Approximately 90 percent of the production will be dry gas which can be used for domestic or commercial purposes. In full operation the unit will produce several hundred barrels per day of natural gasoline which will be suitable for blending with refinery stocks into motor gasolines.

Liquefied petroleum gas or propane, extensively used as a domestic fuel in many areas, will also be a byproduct of the plant on a basis that will considerably increase the available supply in western Canada. A third byproduct will be butane to become available to the commercial market as gas enrichment material, a solvent or as special engine fuel.

About $4 million is to be spent this year by Northwestern Utilities Ltd., the company which supplies gas to Edmonton, Red Deer and other communities in central Alberta. The intention is to supply about 4,600 new customers in addition to the 37,000 already being served.

Northwestern's supplies will be augmented by contact with the Leduc field to be added to those from the company's own wells in the Viking-Kinsella gas field. The budget includes $450,000 for an eight-inch pipeline from the Leduc field to Edmonton. Connections from the main line will also be made with Fort Saskatchewan and the new oil refineries in the southeast of Edmonton. Other sums will be used for distribution lines, meters, new intermediate pressure lines in Edmonton and other construction work required by increased demands for the product. The drilling of six new gas wells in the Viking-Kinsella field together with pipeline extensions there will take $934,500.

Canadian Western Natural Gas Co. Ltd., supplying Calgary and southern Alberta areas, will spend $2 million in the current year to take care of increased numbers of consumers and for additions and improvements to its plants. Two new wells will be drilled in the Bow Island field, and improvements of various kinds are to be made to Calgary's transmission system.

A paradox surrounds Alberta's gas export question. New gas reserves are needed, and needed urgently, in southern Alberta to reinforce supplies received from Turner Valley. Calgary, Lethbridge and the surrounding area are in great need of this. New reserves are needed in the north as well.

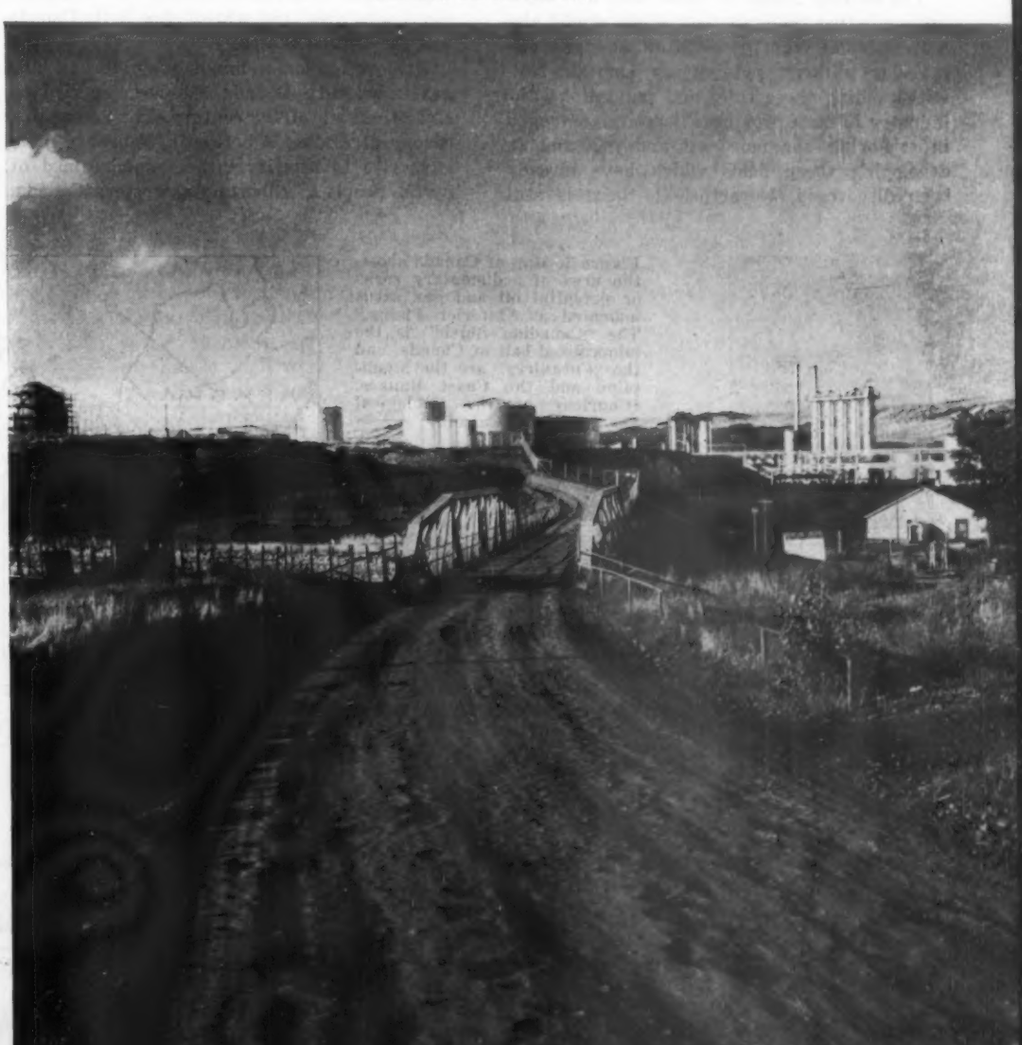
These would quickly appear and be speedily developed if there were any definite assurance that natural gas export was to be permitted. Without this assurance there remains the problem as to where additional supplies are to come from. Proposed extensions to Banff, Raymond, Exshaw, Magrath and other communities cannot be carried out till this is settled.

International Utilities Corp. of New York, which has a large share in Alberta's gas distribution, stated quite recently in its annual report that there is no conflict between export of natural gas and the assurance to Alberta users that their requirements will be given protection.

The best guarantee for the continuance of supply to home users will be the knowledge that markets beyond the province will be created. With that knowledge Alberta's major gas reserves will then be developed.

In other words, the greatest assurance of sufficiency of gas for home supplies lies in the official assurance that it will be exported.

Royalite gasoline plant and experimental laboratories in the famous Turner Valley field. Parks photo for Standard Oil Co. (N. J.)



Western Canada's Oil and Gas Potentialities

BY DR. THEO. A. LINK

WESTERN Canada is regarded by the oil and gas industry as one of the last frontiers where exploration and orderly development can be carried out under laws and regulations framed by the Anglo-Saxon way of thinking, namely, private enterprise. However, the situation is not entirely comparable to those areas in the United States and eastern Canada where the surface owner controls the sub-surface mineral, gas and oil rights. The provinces control most of the sub-surface mineral rights in western Canada, and permits to prospect and develop are under provincial control from the outset. Because of this there is some suggestion of socialism interjected in the rules and regulations whereby private enterprise may operate in the western Canadian provinces.

The general theme of these laws and regulations is that the state as a whole should also reap benefits from possible oil and gas discoveries without putting up capital. Notwithstanding these rules and regulations, the industry in most provinces is actively engaged in exploring for more oil and gas and in developing those fields which have already been discovered. Nevertheless, there is still some uncertainty in view of the fact that rules and regulations may be altered and made retroactive "at the discretion of the minister." There is also the general feeling that more favorable rules should be adopted as the terrain becomes less accessible.

That there is plenty of room in western Canada to look for new oil and gas fields is apparent by examining a generalized geological map of Canada, on which is indicated (Fig. 1) the sedimentary basin area of western Canada, (shown on the map as "Interior Plains",) wherein there are possibilities for discoveries. This sedimentary basin area is roughly 800,000 square miles in extent and could easily accommodate the five largest oil-producing states of the Union. This is obvious from Figure 2, a map of North America showing location of oil fields within the sedimentary basin area (in white) for both Canada and the United States.

Exploration on a minor scale for oil and gas in western Canada has been carried on since the turn of the century. The recent discovery at Leduc, Alberta, in February 1947 gave rise to activity hitherto undreamed of by the people of Alberta and western Canada, many of whom have had occasion to live through various "oil booms," most of which were caused by the discovery in 1914 of gas and later oil in 1936 in the well-known Turner Valley oil and gas field of the Foothills. These booms always gave rise to the formation of stock-promotion schemes, and few, if any,

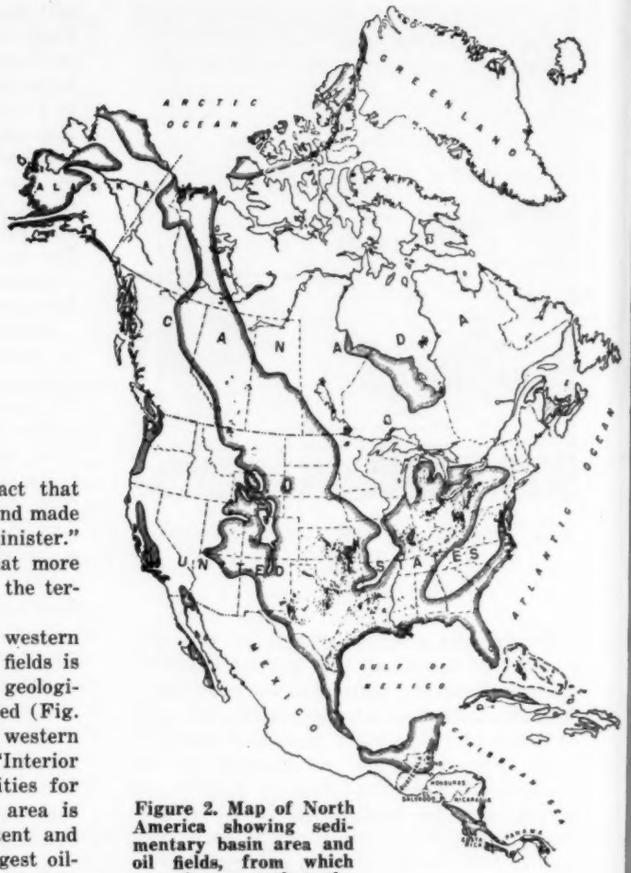


Figure 2. Map of North America showing sedimentary basin area and oil fields, from which may be seen that the western Canada sedimentary basin area is large enough to embrace the five leading producing oil states of the Union. (Courtesy of A.A.P.G., by L. G. Weeks.)

Theo. A. Link, consulting geologist with offices at Toronto and Calgary, has specialized in the geology of Canada since he resigned as midcontinent field geologist of Empire Gas and Fuel Co. in 1918 to become assistant geologist for the Geological Survey of Canada. He left this post in 1919 to become a field geologist for Imperial, working from Fort McMurray north to the delta of the Mackenzie River. He was in this area when the Norman Wells discovery was brought into production in 1920. After numerous assignments for Imperial, including three years in charge of field work for Tropical Oil Co. in Colombia, Dr. Link was made chief geologist for Imperial. He resigned two years ago to enter consulting work.

Dr. Link is the author of many technical papers published in geological journals and oil industry trade papers. An instance of his pioneering thought was an article dealing with "Geological Survey from the Air," published in World Petroleum in 1931. He is a member of many scientific societies, has served (1949-50) as a vice president of the American Association of Petroleum Geologists and is currently vice president of the Geological Association of Canada of which he is a charter member.

Figure 1. Map of Canada showthe area of sedimentary rocks or potential oil and gas areas indicated as "Interior Plains." The "Canadian Shield" is the mineralized belt of Canada, and the "Cordillera" are the Mountains and the Coast Ranges. (Courtesy of the Geological Survey of Canada) →

Figure 3. Core taken from the D3 coral-reef producing horizon in the Redwater field showing excellent porosity. Diameter of core 3¼ inches. (Courtesy Imperial Oil Ltd.)

Figure 4. Geological age sequency indicating position of surface and sub-surface manifestations of oil and gas in western Canada.

GEOLOGIC AGE CHART INDICATING SURFACE SEEPAGES AND SUB-SURFACE ACCUMULATIONS OF OIL AND GAS IN WESTERN CANADA

SURFACE MANIFESTATIONS	ERAS	GEOLOGIC PERIODS	SUB-SURFACE ACCUMULATIONS OBTAINED BY DRILLING
	CENOZOIC	TERTIARY	
Oil and Gas seepages in Foothills Belt	MESOZOIC	UPPER CRETACEOUS	Large Gas Reserves in Viking, Bow Island, Pelican, S.S. throughout Alberta. Small oil wells Viking S.S., Edmonton Area
"Tar Sands" of Athabasca River; Oil and Gas seepages in Foothills. Oil seepage north of Good Hope, N.W.T.		LOWER CRETACEOUS	Heavy Oil Lloydminster, Wainwright, Vermilion Fields. Light Oil Edmonton Area and large Gas Reserves; light oil and gas Turner Valley
		JURASSIC	Med. grade Oil in several small fields S. Alta (Taber, Conrad etc.); light oil and gas Turner Valley.
		TRIASSIC	Oil stained cores, Peace River Area
		PERMIAN	
	PALEOZOIC	PENNA.	
Outcrops in Mts. show cavernous L.S. with tar		MISS.	Gas and Light Oil Turner Valley, Jumpingpound, Pincher Creek (Foothills Area) Light Oil, Barrhead, Gas and Oil Hanna Area. Gas and Oil, Princess-Stevenville and S. Alberta
Oil seepages Norman Wells and Windy Point, N.W.T., Vermilion Chutes, Alta.		DEVONIAN	Light Oil and Gas, Norman Wells N.W.T., Normandville, Redwater, Leduc-Woodbend, Golden Spike, Bon Accord, Stettler. Gas and Oil Princess-Stevenville Area.
		SILURIAN	
		ORDOV.	
		CAMBRIAN	Light Oil (not commercial) Ram River, Alta; Shows of Oil and Gas Edmonton Area
Oil seepages, Cameron Brook, Waterton Lakes Park, Alta; Sage Creek, Flathead Valley, B.C.		PRE-CAMB.	

major companies from the United States participated. Some of the local companies formed during such booms have weathered the storm and are now operating outside of Turner Valley. They have been given renewed impetus by the discoveries at Leduc, Redwater, Stettler and other fields and are doing exploratory work on a large scale.

As a result of this recent acceleration of exploration and development, Calgary, Alberta, the self-termed "oil capital of western Canada," is experiencing a boom much more substantial than previous ones, and this is shared by Edmonton, the capital of the province, the latter being situated nearer to the newly-discovered fields than Calgary. Auctions staged by the provincial government and involving millions of dollars for oil leases in proven and semi-proven fields are now accepted as regular occurrences. At the present time one of the common topics of conversation is the question, "Who will build the pipeline to transport gas from Alberta to the West Coast? What will be the route, and why won't the government officials give this permit immediately so that those who have already found gas will have an outlet, and those who continue to drill for oil will have further incentive to drill more holes in the event that gas alone is found?"

The building boom in Calgary and Edmonton has not reached its peak, and the increase in population of these two cities is giving rise to many other businesses not directly related to the oil industry. The amount of oil actually discovered in western Canada to date and the effort expended by the industry to find this oil is, when compared to the oil-producing areas of the United States, rather small. However, if one considers the vast amount of prospective oil and gas area in western Canada and assumes the expenditure of the same amount of effort as has been the case in the United States in an area of equal size, the possibilities are indeed beyond the most optimistic prognostications.

The year 1949 was the first during which western Canada was being explored on a scale comparable to that of oil areas within the United States. In a report by Dr. F. H. Lahee, drilling in the principal producing areas of the United States in 1949 reached a total of 34,798,291 feet in 9,508 exploratory holes, divided between 1,830 producers and 7,228 dry holes.

This means that 20.2 percent of the holes drilled and 24 percent of the footage drilled were successful in 1949. One producer foot was drilled for every 3.16 feet of dry hole. One successful well was drilled for every 3.95 dry holes. The average depth was 3,842 feet.

In western Canada in 1949, 262 exploratory holes were completed, 58 of these being producers and 204 being dry holes. The producers included 37 oil wells, 19 gas wells and two condensate wells. A total of 1,130,563 feet was drilled, 243,343 feet in producers and 887,220 feet in dry holes. This means that 21.37 percent of the exploratory holes and 21.52 percent of the exploratory footage were successful. There were 3.6 feet drilled in dry holes for every foot drilled in producers. For every producer completed, 3.5 dry holes were abandoned. The average depth of all the exploratory holes was 4,315 feet.

These data seem to indicate that oil and gas finding results in western Canada are comparable to the average for all of the United States, and the logical corollary to this appears to be that, if the exploratory effort were increased in western Canada, the discoveries would increase correspondingly.

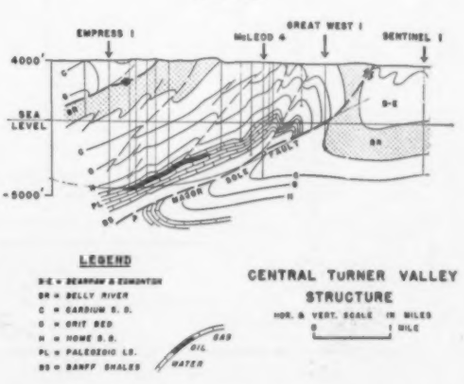
It is of interest to note that by far the greater part of this recent activity in western Canada is attributed to the fact that during Devonian time (several hundred million years ago more or less), the greater part of North America lay under a shallow sheet of marine water which was teeming with primitive life, causing the growth of what the geologists and naturalists term "coral reefs" (bioherms), similar to those found today in the Bahamas, Florida Keys, the Great Barrier Reef of Australia, the South Pacific islands and other places. It is within these calcareous or dolomitic mounds or reefs of the Devonian period that most of the recent oil discoveries of Alberta are being made, and similar conditions are being found within the Pennsylvanian period of central and west Texas, such as Scurry county. Figure 3 is a diamond core of a reef type limestone taken from one of the Redwater wells from a depth of about 3,300 feet.

Geologists have been aware of oil and gas accumulations in "reefs" ever since E. Russell Lloyd first called attention to this type of accumulation in 1929(1), but strangely enough, many oil geologists paid little attention to such possibilities outside of the west Texas and New Mexico area until three years ago when the discovery at Leduc, Alberta, was made far to the north in Canada. Now most geologists have gone "reef crazy," and records of older fields are being dug up to demonstrate that many of them were in fact reef types of oil and gas pools. Many reef discoveries have been made in Texas since Leduc came in.

The coral reef or bioherm type of oil and gas reservoir or trap is not as easy to detect beneath the surface as are structural traps such as anticlines, even with the latest geophysical exploration methods available. Consequently new discoveries will be more difficult. In fact, the industry is beginning to recognize that stratigraphic and "facies change" geology must be applied and resorted

(1) "Capital Limestone and Associated Formations", Bull. of Am. Assoc. of Petr. Geol., Vol. 13, p. 645-58 (1929), by E. Russell Lloyd.

Figure 5. Cross-section through central part of Turner Valley gas and oil fields. Example of oil and gas accumulation in over-thrusted and folded structure, or "structural trap," Foothills belt, Alberta.



to more than has been the case in the last decade or two during which geophysical methods came to the front. In other words, there must of necessity be a swing back to an application of stratigraphic geology in conjunction with geophysical methods because neither will do as well without the other. Therefore, these companies which tend to lean too heavily on geophysical methods alone and choose their top exploration personnel accordingly may find themselves falling behind in the next decade, unless a direct method for finding oil or gas pools is evolved by the geophysicists or chemists. It is just as ridiculous to map anomalies in an area where the geological column is unsuitable for the generation and accumulation of oil or gas as it is to go hunting pheasants in an area where they do not thrive.

This brings us back to Alberta or western Canada again, where, previous to the Leduc discovery, the geologists were aware of coral reef conditions in the Fort Norman area far to the northwest, as well as oil and gas possibilities in the Devonian, as attested by the following quotation from a symposium prepared by Alberta geologists[2] in 1941:

"However, great interest attaches to the Devonian, particularly the Upper Devonian, since it has a fairly widespread petroliferous or bituminous character in outcrops and yields commercial production at Fort Norman in the Mackenzie River district; some slight production at Moose Mountain; showings at Clearwater and Prairie Creek in the southern Foothills; and at Steveville on a branch of the Sweetgrass Arch."

Both the Leduc and Redwater pools were discovered on the basis of seismic reflection surveys conducted for Imperial Oil Ltd. By far the greater majority of wildcat locations made since that discovery have been based upon similar seismic reflection surveys, and other pools such as Excelsior, Bon Accord, Golden Spike, Stettler and Normandville were also discovered as a result of such surveys. However, many of these seismic anomalies were not clearly as defined or outstanding as was the Redwater anomaly, and by far the greater majority have not resulted in the discovery of new pools.

Others which were more outstanding anomalies have also been drilled and did not result in the discovery of oil or gas pools. In one case in particular, the seismic reflection survey showed an outstanding anomaly of considerable proportions, but unfortunately the prolific D3 coral-reef zone of the Redwater and Leduc fields was found at the unconformity between the Devonian and Cretaceous and resulted in the discovery of only small shows of heavy oil with water. This is an example of where the structural conditions were favorable but the stratigraphic conditions were not.

Numerous other locations with weak seismic anomalies have been drilled where the D3 zone was found to be present but contained nothing but salt or sulfur water. Thus it is apparent that the search for oil and gas pools will require the greatest cooperation between stratigraphic geologists and geophysicists to obtain the optimum benefit from both. Furthermore, the importance of competent and alert well-site geologists at all wildcat locations cannot be overemphasized. Coring, drill-stem testing and electrologging, when employed intelligently, can be, and in many cases have been, the factors leading either to success or failure. The overall or regional geological study of well log data will play an increasingly important role toward further discoveries.

Oil and gas manifestations in the form of seepages and shows of oil or gas by drilling as well as commercial production from the geological column for western Canada are indicated on Figure 4. Without going into details of the stratigraphic column, which may be found in many recent technical journals, it may be stated that there are gas and oil possibilities from practically the entire geological column beginning at the base (that is, the top of the Pre-Cambrian) and upward.

Oil and gas shows have been encountered in the Cambrian rocks of the Foothills as well as in the Plains area but not in commercial quantities. To date no definite shows of oil or gas can be demonstrated to have been obtained from the Ordovician, and the same applies to the Silurian. However, rocks in both of these geological periods could yield oil or gas under favorable conditions. As may be gathered from the foregoing chapters, the Devonian appears to be the most prolific of oil, with the Mississippian rocks running second with good possibilities of other discoveries in addition to Turner Val-

(2) Alberta Society of Petroleum Geologists, "Possible Future Oil Provinces in Western Canada", Bull. A.A.P.G., Vol. 25, No. 8, Aug. 1941, p. 1452.

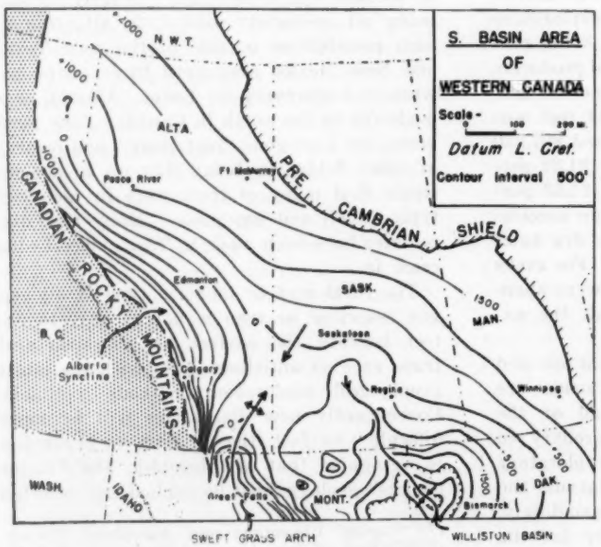
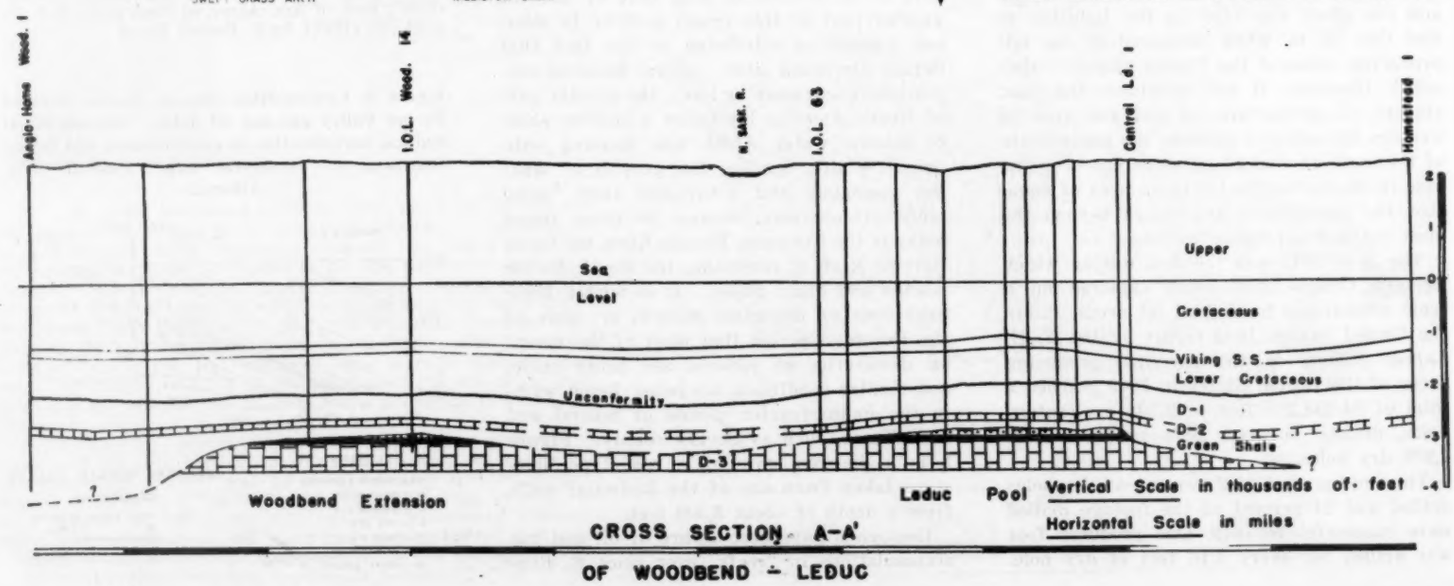


Figure 7. Generalized structure-contour map on top of the Lower Cretaceous in the southern part of the western Canada sedimentary area. Map indicates location of Williston Basin, Sweetgrass Arch, Alberta Syncline and the Foothills to the east of the Canadian Rockies.

Figure 6. Cross-section through the north end of Leduc-Woodbend oil field. This is a "stratigraphic-trap" type of oil accumulation in a coral-reef, marked D3 on the diagram, a dolomitic producing horizon of Upper Devonian age. The overlying D2 zone is also oil-producing in this area. Draping of later sediments over the D3 zone is indicated on the diagram.



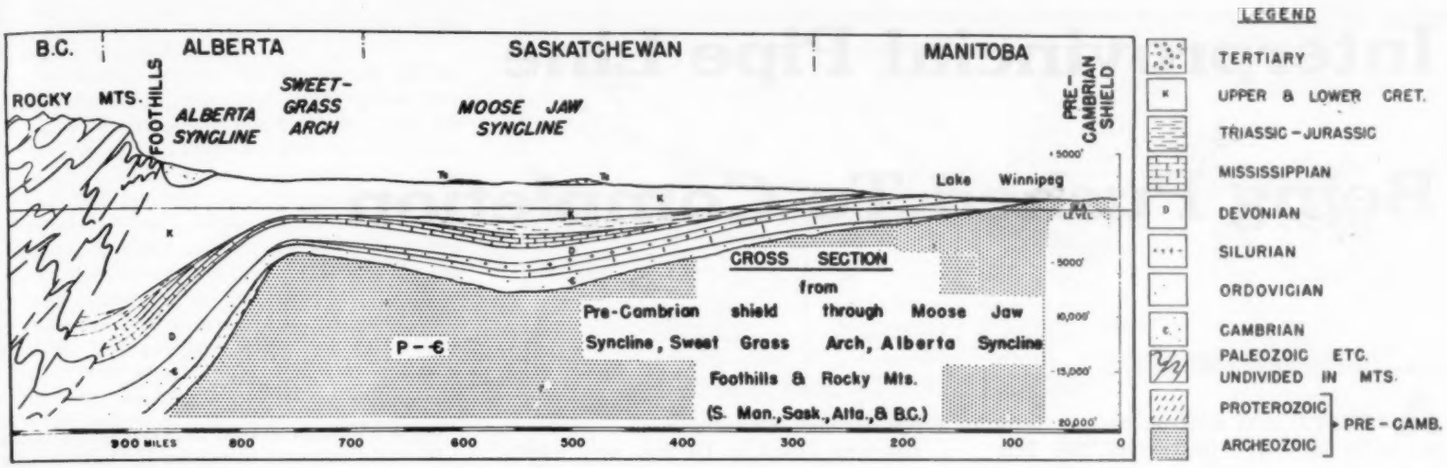


Figure 8. Generalized cross-section through southern portion of western Canada sedimentary basin area. Cross-section begins at Pre-Cambrian shield to the east of Lake Winnipeg, passes through the Moose Jaw Syncline, the Sweetgrass Arch, the Alberta Syncline, the Foothills belt and the Rocky Mountains. Most of the larger oil fields discovered to date are on the east flank of the Alberta Syncline in Upper Devonian coral-reef reservoirs.

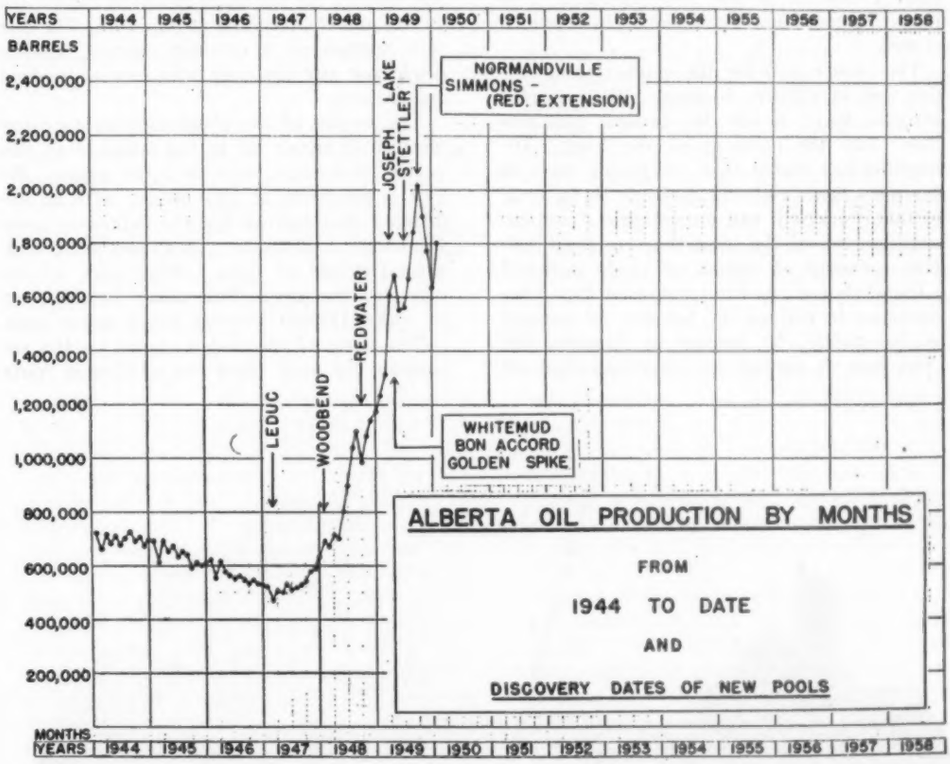


Figure 9. Graph showing Alberta oil production from Jan. 1, 1944, to Jan. 1, 1950. The decline of the curve was arrested when Leduc was discovered in 1947, and since then there has been a steady upward swing of the curve in spite of strict proration. Discovery dates of the recent pools are indicated on the diagram. Seasonal market demands cause the month by month fluctuations.

ley, Jumping Pound and Pincher Creek, for not only gas but oil. To date nothing tangible has been obtained from the Pennsylvanian and Permian, but the Triassic rocks of northeastern British Columbia hold promise for possible future discoveries. In sands of the Jurassic age oil and gas fields have already been developed in southern Alberta, and in sands of the Lower Cretaceous there have been established small fields and many potential gas reserves. The Upper Cretaceous has already been demonstrated to hold promise of very large gas-sand reserves such as the Viking-Kinsella, Bow Island and Foremost gas fields. At the present writing the Upper Devonian, Mississippian and Lower Cretaceous are the geological ages from which the industry expects the most. Nevertheless, possibilities below the Devonian should not be overlooked, and it must be remembered that the famous "tar sands" of the Athabaska River of Lower Cretaceous age are a large oil reserve for the future.

Oil and gas accumulations in western Canada are due to both the stratigraphic and structural type and combinations of these. Figure 5 is a cross-section of the Turner Valley gas and oil field of the outer Foothills belt which is a structural type of oil and gas accumulation. Figure 6 is a cross-section through the north end of the Leduc-Woodbend field showing a typical coral-reef stratigraphic type gas and oil accumulation in the Upper Devonian. The Redwater and Excelsior fields are of a similar type as is also the Norman Wells pool located a thousand miles to the north of Leduc. Practically all the Cretaceous pools are due to stratigraphic "pinch-out" of sands.

Figure 7 is a generalized structure contour map of the southern portion of the western Canada sedimentary basin indicating the main structural features of that area, while Figure 8 is a generalized cross-section through the more southerly portion of this basin a few miles to the north of the International boundary line.

The oil and gas industry now regards western Canada as one of the most promising sedimentary basin areas in which to prospect for new oil and gas reserves. Due to the vast region involved and the inaccessibility of a considerable amount of the area, exploration for oil and gas will be slowed down as the trend goes northward. However, the industry has in the past, and will in the future, be able to overcome such obstacles if the governments in question issue oil and gas prospecting permits and leases under favorable terms commensurate with the risks involved. Western Canada is at the threshold of an oil and gas development era comparable to that of west Texas in 1924.

To the end of 1949 roughly 3,000 wells have been drilled in Alberta, and many of these to insufficient depths to be regarded as satisfactory tests. Of these about 1,900 are development or exploitation wells within the proven oil and gas fields. It is believed that the total discovered reserves for Alberta range somewhere between one and a half to two billion barrels of oil and some seven trillion cubic feet of gas.

If, as and when 25,000 wells are drilled, the oil reserves should be in the neighborhood of six billion barrels and the gas reserves thirty trillion cubic feet. In other words, if an area has yielded one and a half billion barrels of oil and about seven trillion cubic feet of natural gas by drilling some 1,100 wildcat wells, the drilling of twenty times that many wells should ultimately uncover five times more oil and gas. (Although most Texans don't know it, the province of Alberta is, within 10,000 square miles, as large as the state of Texas.)

Interprovincial Pipe Line

Being Pushed To Completion

ALBERTA is to start on its long journey to the east before the close of 1950. This is the statement made by Dr. Oliver B. Hopkins, president of the Interprovincial Pipe Line Company in the company's first annual report.

The report calls for the quickest construction job in pipeline history. Work started early in May. It was the earliest date possible after the break-up of the frost. Dr. Hopkins has stated that everything possible has been done, and will continue to be done, so that work will run on schedule, "particularly in view of the importance to the Canadian economy of additional crude outlets."

Ownership of the Interprovincial Pipe Line Company is divided as follows: 42 percent by the public; 33 percent by Imperial Oil Ltd.; and 25 percent by other Canadian oil companies and private interests.

Lakehead Pipe Line Co. Inc., as a wholly-owned subsidiary of Interprovincial, will own and operate the 360 miles of line in the United States and the terminal at Superior. The line will operate as a common carrier, moving crude for any producer who meets standard regulations.

The length of the great pipeline to carry western Canada's oil to the lakehead at Superior, Wisconsin, will be 1,150 miles. Its cost is estimated at $90 million, with an additional $2.5 million for the extension from Edmonton to Redwater. High-test steel, with a total weight of about 178,000 tons, will be used for the pipe. This would be sufficient to make 118,000 average sized motor cars.

The route of the line is shown on the accompanying map. Had the all-Canada route to Fort William on Lake Superior been chosen, the distance would have been 120 miles longer and the terrain rocky and broken. This would have involved an additional $10 million cost plus $400,000 extra each year in carrying charges. The route selected avoids towns and other pipeline obstacles.

The field end of the line in Alberta will be at Redwater with the first pumping station at Edmonton. Approval of the extension line from Edmonton to Redwater was given by the Board of Transport Commissioners on March 16.

There are to be six storage tanks at the Redwater field end, each with a capacity of 140,000 barrels. Two of these were completed early in May with work progressing on two others. Work on the terminal facilities at Superior is under way with the construction of the dock which is being reinforced with sheet steel piling. A total of 12 storage tanks will be erected there, each one to have a capacity of 150,000 barrels.

Six pumping stations, as shown on the map, will be stationed at Edmonton, Ermine, Regina, Cromer, Gretna and Clearbrook. In keeping with the Interprovincial's plans for further expansion after the current year, six intermediate pumping stations will be constructed. No date has yet been set for this, but it is understood that the additions will come into effect shortly after the turn of 1950. This will increase the initial capacity of the 20-inch Edmonton-to-Regina section from 95,000 barrels daily to 135,000 barrels daily, and from 70,000 to 100,000 east of Regina. When a daily throughput of larger amounts is required, increased capacity may be provided by installing intermediate pump-

Lake tanker Imperoyal entering locks at Sault Ste. Marie. Photo by Parks for Standard Oil Co. (N. J.)

ing stations or by looping of the line or the laying of a second one.

A special interest in the laying of the pipeline from Edmonton to Superior has been taken by farmers through whose lands the pipe has to go. There are over 2,000 of them, and a field force has been kept busy since last fall signing contracts with the land owners. Some of them, due to owners being absent in other parts of the world, have presented complicated delays. The final transactions were being carried out in May. In most cases the tracts are quarter sections. The owner may not have been living on his land, or it may have been occupied by a tenant. In every case legal authority had to be secured before construction of the line could be carried out.

On signing of the easement, the owner is paid for the total acreage covered by the 60-foot right of way across his land. Market values vary: cultivated land obviously commands a higher price than brush. Other factors influence value. The pipeline, being a trunk line, will remain unmoved below the surface. There will be no question of rerouting.

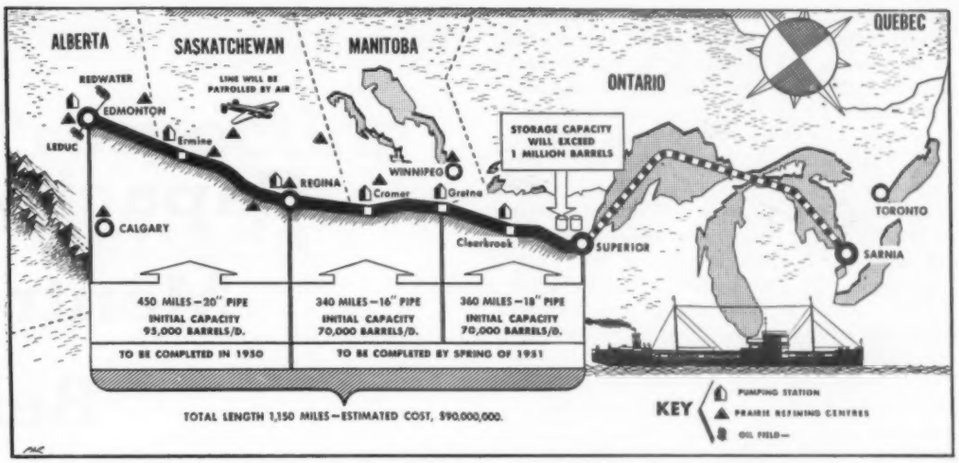
No part of the owner's land is sold in reality. The price paid per acre is merely compensation for the inconvenience at the time pipe is being laid. After the work is finished, there will be no trace of this, and the land can be worked as if it were not there, or it can be sold at any time.

Most of the 2,000 owners in Canada, more than half of them in Saskatchewan, had agreed early in the year to the passage of the line through their lands. Knowing that the work was of national importance, they gave their full cooperation.

In the first week of May, the first move was made in the Hughenden-Edmonton section, ahead of the crews in five other spreads in Alberta, Saskatchewan and western Manitoba, all scheduled for this time. Hughenden is 145 miles southeast of Edmonton.

From Hughenden east to Gretna, Manitoba, the soggy ground delayed the start. West of Hughenden, conditions were better and operations proceeded at a steady mile a day pace.

At some distance behind the huge rotary digger which tore open the ditch in its stride —the trench is five feet deep and thirty inches wide—the welders were moving along at the same rate. A big side-boom "cat" held a joint of 40-foot piping in the air. A hydraulic clamp made the joint fast against another section. The joint was then spot-welded and an x-ray followed testing for flaws.



Route of Interprovincial Pipe Line and of lakes tankers.

The 40-foot piping joints are linked to form 5,000-foot sections. When these are completed, they are plugged at one end and tested with compressed air for leaks which show up as bubbles on the soaped surface of the welding. Stringers then place the 40-foot joints on blocks laid on the ground, and welders complete the welding. Before lowering into the ground, a tarring and wrapping machine does its job on the cleaned and welded pipe.

With this done the cats lower the blackened pipe into the trench which is backfilled by bulldozers. If it is on cultivated land, the ditch is tamped and left level. By this means normal farm operations can be resumed over the right of way immediately the cleanup crews have completed the final job.

Digging crews plan to stay about four to five miles ahead of the pipe laying crews. Lengths of pipe are being shipped into each division, and this work will continue for some time during the summer. They are stockpiled and then strung along the pipeline route where they wait to be welded.

By late spring about 50 miles had already been strung in each direction. More had been stockpiled, waiting for the land to dry out. Many of the fields in early summer were still damp and soggy, the worst section in the prairies being near Gretna, Manitoba.

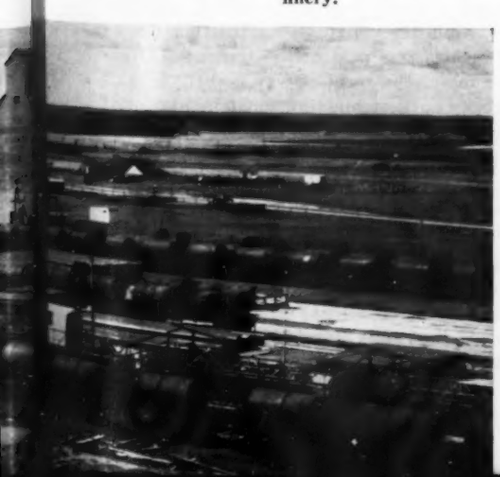
With improvement of weather conditions the line will work from each divisional point westward at the rate of a mile a day. The line from Hughenden is expected to reach Edmonton in September. At the same time it should reach Hughenden from Rosetown, and Rosetown from Regina.

Before the spring thaws set in, the line crossed the Saskatchewan River. It was ditched into the river bottom about eight miles east of Edmonton in the vicinity of Clover Bar. The smaller Battle River was crossed at Hardisty. The pipe at both crossings has been tested and is ready to connect with the main line when it reaches these two. The South Saskatchewan River near Outlook will be crossed later in the year when the water is down.

For purposes of construction the line is divided into three divisions: western, Edmonton to Regina; central, Regina to Gretna; and eastern, Gretna to Superior. The main contractors for the construction are Canadian Bechtel Company, associated with Fred Mannix of Calgary, for the Edmonton to Regina section; Williams Brothers, who laid part of the Montreal-Portland pipeline and have built large gas lines in Alberta, Regina to Gretna; and Anderson Brothers from Gretna to Superior, Wisconsin.

Contract for construction of the five pumping stations in Canada has been let to the Bird Construction Co. Ltd., well known western Canadian firm. Construction started on these stations at the beginning of May. By the middle of May pipe started to arrive from the mills, and the whole gigantic scheme began to get in its stride by this time. Mean-

Tank cars moving Alberta oil to Edmonton refinery.



Pipe laying on the Interprovincial Line. Photo by Danny Scott.

while, the Interprovincial Company was assembling its staff of inspectors and supervisors to take up their duties at the various spreads to which they were allotted, and contractors were testing their welders so as to get competent crews together for the zero hour.

In all, the beginning of May saw 1,000 men assembled for the job. With them was pipe to the value of many millions of dollars at the nine main assembly stations along the route. Only the weather, which was daily improving, was delaying the green light for general operations to begin. When it came, work started simultaneously at all nine assembly points along the route.

It will take 26 days for a barrel of oil to move through the pipe from Edmonton to Superior, and it will take 1,838,000 barrels to fill the line. Cutting the trench in which the pipe will lie buried will require the excavation of more than 2,250,000 cubic yards of earth.

To complete a line of these dimensions over a distance of 1,150 miles in 150 days will set a record for fast construction on a job of this size. Before the line is completed, it will take 5,500 railway cars to transport all the pipe and equipment needed for construction.

Storage tanks at Redwater and Superior are more than 140 feet in diameter. The two largest tankers ever constructed in Canada will be completed and ready for service next year to carry western oil to the Sarnia, Ontario, refinery. Each will have a capacity of 115,000 barrels, and each will be expected to transport five million barrels of oil in an open season across the lakes. Loading capacity will be at the rate of 20,000 barrels an hour and discharge at 15,000 barrels an hour.

Ditching on Hughenden-Edmonton span of Interprovincial Line. Photo by Danny Scott.

Capacity of Portland-Montreal Pipe Line Being Increased

CONSTRUCTION now is in progress on an 18-inch crude line from Portland, Maine, to Montreal East, Quebec. The line is being constructed for The Portland Pipe Line Corp. and Montreal Pipe Line Co. Ltd., which have operated a 12-inch crude line over the same right-of-way since 1942. When completed next November, the two parallel lines will be able to deliver about 127,000 barrels of crude daily as compared with about 80,000 barrels of light crude through the present 12-inch line.

Operating costs of the twin lines will be reduced materially through the closing of five pump stations. In order to pump 69,000 barrels daily last year through the present line, eight pump stations were operated to maintain a line pressure of 750 to 850 psi. With three stations only the line will operate at 650 to 700 psi. Pump stations at South Portland and Waterford in Maine and Lancaster, N. H., will be enlarged by moving pumps and engines from the other existing stations.

The original line was financed and built as a war measure by Standard Oil Co. (N. J.) in 1941. Prior to that Montreal refineries were supplied entirely by tanker during the seven months of open water in the St. Lawrence. Construction of the line lessened the load on the short supply of tankers by eliminating the 2,000-mile haul up the Atlantic coast and down the St. Lawrence. It permitted also a more even flow of crude and reduced storage tank requirements made necessary by the winter freeze-up.

Like many other wartime facilities erected by the petroleum industry, the Portland-Montreal line has proved its economic right to continue in peacetime. With plenty of tankers available for the all-water trip, the line still is more convenient and cheaper for Montreal refiners. At the close of the war the New Jersey Standard sold its entire interest in the line to four Canadian companies, British American, Imperial, McColl-Frontenac and Shell. Imperial owns 40 percent and each of the others 20 percent.

Usage of the line has increased year by year since it first was put into service. Canadian oil consumption has grown rapidly since the end of the war, and Montreal refinery capacity has been enlarged to keep pace. Following is the throughput by years from 1942 to 1949:

Year	Daily Average Barrels	Total Barrels
1942	19,609	7,157,501
1943	31,657	11,554,830
1944	44,582	16,316,912
1945	43,543	15,893,077
1946	52, 484	19,156,879
1947	59,275	21,635,384
1948	67,323	24,640,457
1949	68,563	25,025,668

New construction now under way includes a new 30-inch discharge line from the unloading pier at South Portland to the tank farm. Storage capacity at the farm will be increased to 1,700,000 barrels by the erection of four new 150,000-barrel floating-roof tanks. Storage previously consisted of six 140,000-barrel and two 135,000-barrel floating-roof tanks.

The steel and concrete pier at which tankers are unloaded at South Portland is 882 feet long. It has berths dredged to 35 feet for two tankers. Two unloading lines on the pier are capable of handling 15,000 barrels per hour of light crude. A 16-inch line discharges to two shore tanks, and a 24-inch line goes direct from pier to the tank farm, a distance of three miles.

Primary pump station at South Portland is located at the tank farm. In the present operation it and each of the other seven stations are equipped with two 30,000-barrel triplex and one 20,000-barrel duplex reciprocating pumps. Six are electric and two diesel-driven. By moving pumps from stations to be shut down, the three future stations will be greatly enlarged.

Construction of the new line involves two difficult river crossings, the St. Lawrence and the Richelieu, where there is a swift current and a rocky bottom in which a trench must be blasted. Latex Construction Co. of Houston has this part of the contract. Overland much of the right-of-way is mountainous and rocky so that blasting must be employed generously.

The new line is to be coated and double wrapped. Rock shields will be applied before lowering the pipe into trenches in rocky areas.

Contractors on the line, aside from river crossings, are: Associated Pipe Line Contractors Inc., Houston; Oklahoma Contracting Corp., Dallas; and Fred Mannix Co. Ltd., Calgary.

Geophysical Prospecting In Western Canada

By A. J. BARTHELMES

A. J. Barthelmes, vice president, Seismograph Service Corp.

THE Southern Plains of Alberta have been known as an oil province for many years, primarily through the production of the Turner Valley field which at the time of the discovery of the Leduc field in February, 1947, produced about 90 percent of the total production in Alberta, approximately 87,500,000 barrels of oil.

The Turner Valley field was originally discovered in 1913 when a small amount of light oil was produced from Lower Cretaceous sands. Additional horizons producing both gas and oil were found in 1924, but major crude production was not obtained until 1936 when a large oil and gas reserve was discovered in the Madison lime of Mississippian age on the west flank of the structure. This was a major discovery and its yield soon filled the needs of the Prairie provinces and, for many years, slowed down the search for oil and the development of other fields. However, as production from Turner Valley gradually declined due to exhaustion, oil prospecting and development again became a profitable venture. During this period of decline Leduc was discovered and started the present upswing when it was realized that a new type of reservoir—the coral reef—had been found in Canada. The rapid succession of similar discoveries, such as Woodbend, Redwater, Golden Spike, Stettler, Normandville and others immediately drew worldwide attention. The importance of these discoveries can be fully realized only if their prolific oil and gas possibilities and the tremendous regional extent of the area involved are considered.

The Western Canada Basin extends from the United States border north and northwestward for almost 2000 miles to Alaska and the Arctic Ocean. Stretching across the width of the southern border of the provinces of Alberta, Saskatchewan, and Manitoba, about 800 miles wide, it covers the area between the Rocky Mountains to the west and the Pre-Cambrian Shield to the east (see Figure 1). Because of the westward extension of the Canadian Shield in northern Saskatchewan, the basin narrows to about 500 miles in the extreme northern parts of Alberta and British Columbia, and further narrows in the vicinity of the Norman Wells pool in the Northwest Territories to less than 200 miles in width. This tremendous basin, comprising an area more than three times as large as the entire state of Texas, contains some 800,000 square miles of sedimentary deposits varying in thickness from zero at the edge of the Pre-Cambrian Shield to more than 13,000 feet in the deepest part of the Alberta Syncline, at the edge of the Foothills Belt in front of the Rocky Mountains.

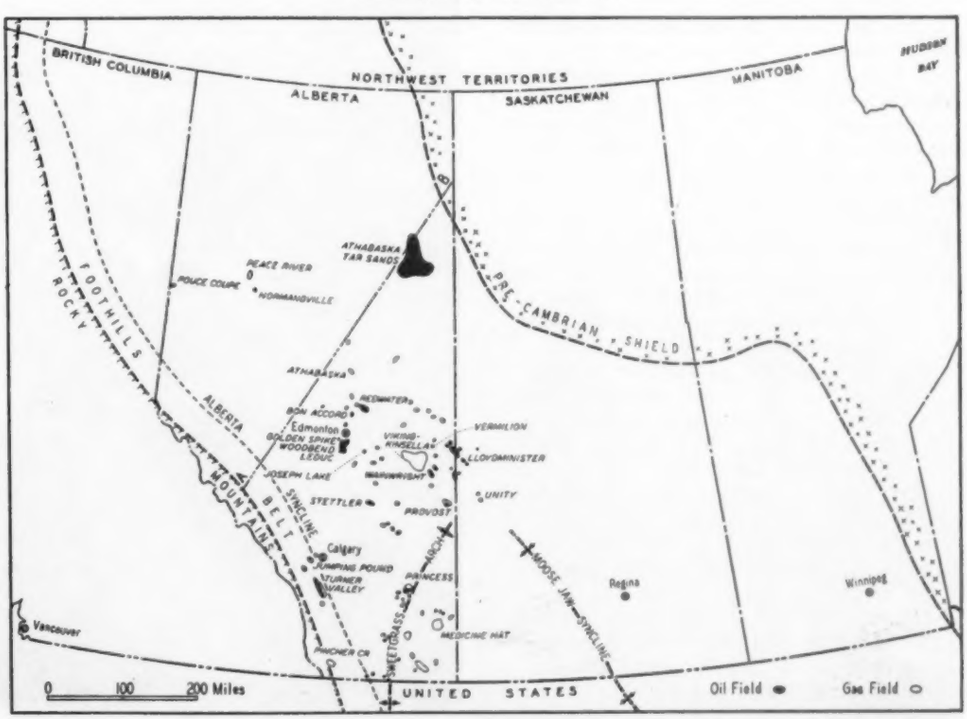
The full value of the present status of oil exploration in Western Canada and its future possibilities is more easily understood if one looks at the geology of this immense basin as a whole. A brief review of the regional geology is, therefore essential for such an understanding.

The sedimentary basin, though of the utmost complexity in certain limited areas, such as the Foothills Belt, is in its major parts of remarkable simplicity as far as the general regional geology and its tectonic movements are concerned.

The regional picture can best be demonstrated by a generalized cross section extending from the Pre-Cambrian Shield in northeastern Alberta across the basin in a southwesterly direction to the edge of the Rocky Mountains, as shown in Figures 1 and 2. All formations from the Cretaceous down to the Cambrian show a general gentle dip to the west and southwest. This dip, however, is accentuated more and more when approaching the Foothills Belt, where the sedimentary rocks increase in thickness to well over 13,000 feet in the lowest part of the basin, and where the basin terminates abruptly against an enormous thrust fault forming the eastern edge of the Foothills Belt (see also Figure 6).

The rather uniform, gentle dip of the eastern basin flank is interrupted in the ex-

Fig. 1—Western Canada basin



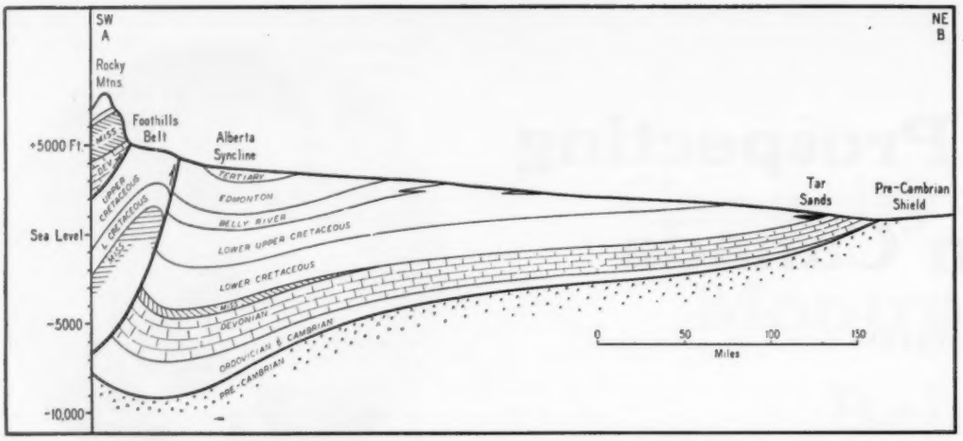


Fig. 2—Western Canada basin—cross section A-B

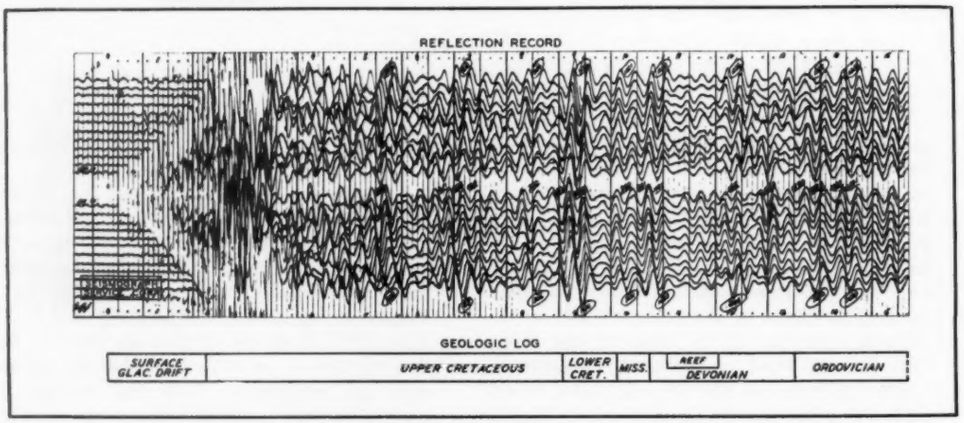


Fig. 3—Reflection record and geologic log reduced to the same scale

(5) CORAL REEF fields on the east flank of the Alberta Syncline, such as Leduc-Woodbend, Redwater, Golden Spike, Stettler, Normandville, and Norman Wells.

Discovery of the many oil and gas pools in the Western Canada Basin in such a short time would not have been possible without the help of geophysical exploration methods. Magnetometers and gravity meters were used for general reconnaissance surveys, but the most important tool for reconnaissance as well as detailed surveys has been the seismograph. Its accuracy and adaptability have been utilized to a steadily increasing degree, and it is now recognized as the most reliable and efficient method available in prospecting for oil and gas.

The basic principle of the seismic method is rather simple. A seismic or elastic wave is created by firing a dynamite charge in a shot hole drilled at location A (see Figure 4). This wave travels downward until parts of its energy are reflected from the interfaces between certain formations such as shale and limestone which show a marked difference in their physical properties and, therefore, represent favorable reflecting horizons. The arrival time of the reflected wave is then recorded at location B and is used to calculate the depth of the reflecting layer. This method is known in seismic prospecting as the "reflection method." A typical reflection record obtained over a recent reef discovery is shown in Figure 3 with the various reflections identified by their geologic age, and the reef zone marked on the geologic log.

treme southern part of the basin by the Sweet Grass Arch which extends from Montana across the international border into southern Alberta and separates the Alberta Syncline from the Moose Jaw Syncline in southern Saskatchewan.

This large basin, though originally thought to be simple and uniform in its structure and stratigraphy, is however astounding in its multitude of different types of geological anomalies that allow an accumulation of oil and gas in such large quantities as found in earlier days in the Tar Sands area and later in such prolific fields as Turner Valley, Leduc, and Redwater. There are at least five entirely different conditions under which such a prolific accumulation has been found so far:

(1) The ATHABASKA TAR SANDS AREA which outcrops along the Athabaska River.

(2) PINCH-OUTS which have formed stratigraphic traps on the east flank of the Alberta Basin, such as Viking-Kinsella, Bon Accord, Vermilion, and Athabaska.

(3) CLOSED STRUCTURES with little relief which formed structural traps within the Basin proper, mostly located on the northward extension of the Sweet Grass Arch.

(4) HIGHLY FAULTED AND FOLDED STRUCTURES of the Foothills Belt, such as Turner Valley, Pincher Creek and Jumping Pound.

Preparing instrument set-up in Muskeg area

There are many different varieties of reservoirs where oil and gas have accumulated. The discovery of additional reservoirs will depend on the proper direction of the exploration efforts and the logical application of the geophysical tools, both of which are controlled by the geological conditions existing in the various types of reservoirs to be expected. The geology and the application of the geophysical methods best suited for exploring its possibilities are discussed in the following paragraphs, and are illustrated in Figures 4 to 7 for the major types of oil and gas accumulation known up to this date in the Western Canada Basin:

(1) The Athabaska Tar Sands represent the greatest accumulation of oil known in the entire world. These sands outcrop near Fort McMurray, about 250 miles northeast of Edmonton and form a huge lens which dips to the southwest beneath the overlying younger formations and pinches out about 150 miles farther down the Alberta Syncline. They are of Lower Cretaceous age, resting on the Devonian, and consist of white quartz sand saturated with viscous oil. It is believed possible that the oil had the underlying Devonian as a source rock and has seeped into Cretaceous sands from a truncated Devonian surface. The amount of oil contained in these sands is estimated as high as 300 billion barrels and may be larger than the entire known oil reserve of the Western Hemisphere.

Efforts to separate the bitumen from the sand and to produce oil commercially from the Tar Sands date back to 1913 when the Dominion Department of Mines actually started an exploitation project. However, as a result of the discovery of other prolific oil fields in Alberta, production of oil from the Tar Sands was abandoned and future development of this tremendous potential source of oil has been delayed. It will not depend on further exploration efforts, but solely on an economical technique suited for commercial exploitation. This area will surely become invaluable at some future date when the other reserves become exhausted.

(2) Pinch-outs along the east flank of the basin, west of the Tar Sands area, form many stratigraphic traps favorable to the accumulation of oil and gas. The Upper and Lower Cretaceous are characterized by their numerous sand lenses which pinch out northeastward into shale and thus form ideal traps for oil and gas. Also, older formations such as the Madison lime of Mississippian age and the D-1 Zone of Devonian age pinch out northeastward against the Pre-Cretaceous unconformity.

Figure 4 shows such pinch-out possibilities, and it must be realized that the accurate delineation of these reservoirs by geophysical methods is extremely difficult. The seismograph has been used primarily for the evaluation of structural traps. However, for many years efforts have been concentrated on methods to delineate pinch-outs and similar stratigraphic traps. Though the seismograph has in past years not contributed much to the discovery of pinch-outs in the Alberta Basin, it is believed that further study and development of suitable methods will succeed in this field. The West Edmond field, a typical stratigraphic trap in Oklahoma, was surveyed in its entire area with the seismograph without revealing its possibilities. A review of the old reflection records, which were obtained from horizons above and below the pinch-out zone, suggests that with the help of isopach studies and with the necessary broad view of the regional geology, this field might have been discovered years earlier by the seismograph.

By applying the most accurate instruments and the highest skill of the interpreter, a seismic method has recently been perfected by the writer's company which permits in Oklahoma the mapping of oil bearing shoestring sands less than 1000 feet wide and only 40 to 60 feet thick. These developments suggest that similar methods and techniques may also be developed and utilized eventually for the discovery of numerous pinch-out fields not yet discovered in the Alberta Basin.

(3) The Closed Structure or anticlinal fold as illustrated in Figure 5 is the most conventional type of oil trap and can be discovered without difficulty by a seismograph survey as long as there are one or more reflecting horizons present. Unfortunately, the east flank of the Western Canada Basin is almost bare of large geologic structures. Only small anomalies of this type are known to exist on the Sweet Grass Arch, and little production has been found, although in other areas such structures are known for their prolific accumulation of oil.

In earlier years the exploration efforts in the Alberta Syncline concentrated on the location of structural anomalies, especially on the regionally higher area of the Sweet Grass Arch. However, when it was found that there was little folding and apparently no other structural features of tectonic origin present under the plains, the Western Canada Basin was considered by many geologists as a poor area for oil exploration, until the discovery of the Leduc field started a new activity.

(4) Highly Folded and Faulted Structures. This type of structure is found in the Foothills Belt along the Rocky Mountains. Blocks of sedimentary rocks have been thrown upward and thrust over the younger formations of the westerly portion of the Alberta Syncline (see Figures 2 and 6). The folds are frequently overturned and further complicated by local faulting, forming upthrown and downthrown wedges which result in the most complex type of structure to be encountered. The Turner Valley field is such a structure, the complexity of which was revealed by the many wells drilled in this field. The Pincher Creek and Jumping Pound fields represent similar structures, which were first located by seismograph surveys.

The seismograph is the most valuable tool that will allow the outlining of the general structural attitude of these folds and faults. Directional and three-dimensional shooting techniques are necessary, and the interpreta-

Recording truck in the plains area during winter time

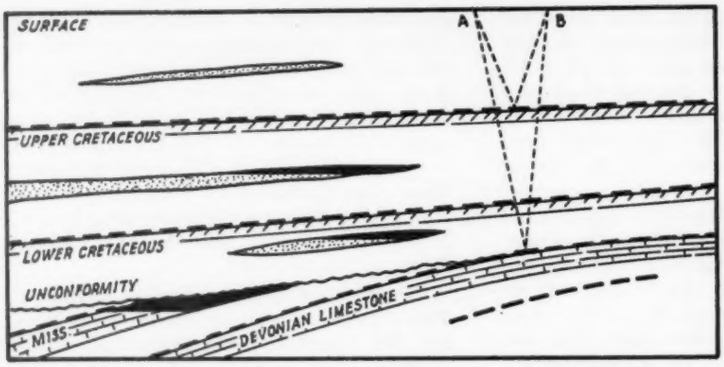


Fig. 4—Pinch-outs

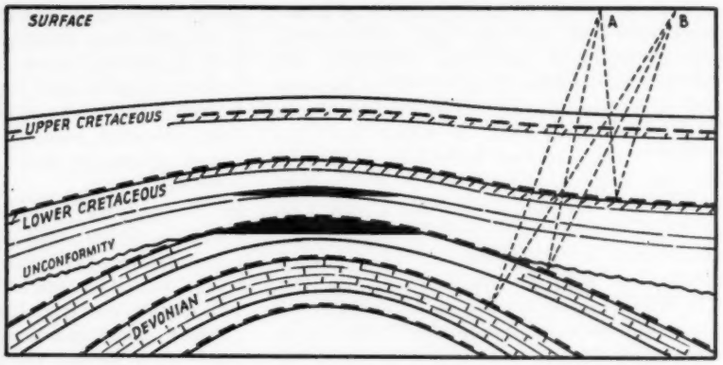


Fig. 5—Geologic anticline

tion of conflicting dip data requires the highest skill of geophysicist and geologist. Special dip shooting techniques applying reflection and refraction shooting will not always allow a unique solution of the complex geology, but they will furnish a large number of individual dips which, though showing very little continuity in the sub-surface, will enable the skillful interpreter and geologist to reconstruct the general attitude of the formations.

(5) Coral Reefs. With the discovery of the prolific reef production at Leduc, exploration efforts were suddenly revived and were almost entirely directed toward the search for Devonian reef production. During the following years new reef production was found in rapid succession, chiefly by the seismograph, in the Leduc-Woodbend, Redwater, Golden Spike, Stettler, and Normandville pools and thus intensified the exploration efforts, especially in the still unexplored but potentially productive areas in the northern portion of the sedimentary basin.

The coral reef or bioherm is a vertical accumulation of the secreted hard parts of certain organisms, such as corals, bryozoans, algae, and others that lived below the surface of the water and formed mounds and ridges on the previously deposited sediments. These reefs generally show very little stratification. Their rigid mass withstands any compaction under the weight of overburden, while the adjacent sedimentary rocks settle considerably under the heavy weight, thus creating a draping of the strata over the reefs (see Figure 7).

The experience gained in recent years in West Texas and in the Illinois Basin in delineating reef structures by seismic surveys helped materially in developing suitable seismograph techniques and interpretation methods for reef detection in the Alberta Syncline. Geological conditions in this area are considerably more favorable for seismic exploration than in many other areas, since reflecting beds frequently can be followed continuously above and below the reef zone. Furthermore, the reefs are flanked by highly compacted shale formations which caused draping of the overlying formations. Such draping is recognized by increased dips recorded on the reflecting horizons above and adjacent to the reef. Another valuable interpretational advantage is derived from the high velocity of seismic waves in the reef material as compared with the relatively low velocity existing in the surrounding shale formations. Reflection data from horizons below such high speed areas are affected by the shorter travel time recorded. These phenomena, if recognized by careful analysis and isopach studies, help materially in the final interpretation of reef structures.

Figure 7 indicates the various reflected energies observed from different directions which must be properly evaluated, calculated, and displaced on cross sections to reconstruct the actual conditions present in the subsurface. Actually, there are very few reflections received from the top or the flanks of the reef itself. It takes, therefore, a great amount of experience and the highest skill of the seismic interpreter to sort the reflections recorded by the seismic instruments and arrive at a reliable and accurate interpretation of the subsurface.

Geophysical prospecting in the Western Canada Basin has undergone many changes and has had to adjust itself to the new problems it was called upon to solve from time to time. There have been three separate periods in which the operations called for different methods and techniques with regard to equipment, personnel, and transportation requirements.

In the early days—up to the discovery of Leduc—practically all of the operations were carried out in the open plains of Alberta and Saskatchewan, where the partly cultivated and well-populated country presented few problems in moving equipment and finding suitable living accommodations for crew members. The standard seismograph party is composed of six units: a recording truck, a shooting truck, a drill truck, a water truck, a survey car, and a party chief's car. Standard truck equipment was sufficient to move this equipment in the plains country during most of the year, except for the extreme winter months when operations were unusually interrupted until the following spring, after the end of the thawing season.

The second period started with the discovery of Devonian reef production along the east flank of the Alberta Syncline and the realization that similar reef areas may be present to the north and northwest of the newly discovered fields. The lease play and the exploration program that followed therefore extended rapidly into the area north of Edmonton, into new and undeveloped territory consisting of the now famous bush and muskeg country. Large forests cover the plains type topography, characterized by its

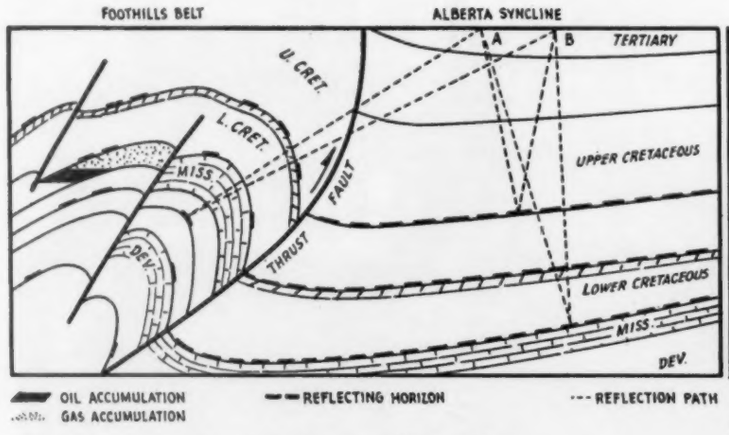


Fig. 6—Faulted and folded structure

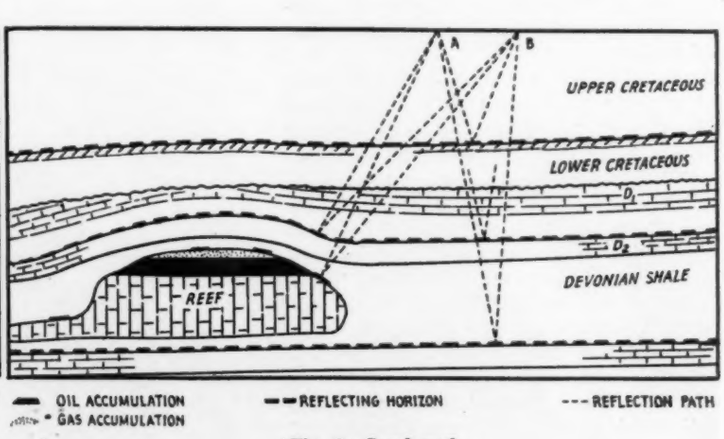


Fig. 7—Coral reef

large undrained areas covered with muskeg, a combination of water, mud, and vegetation, varying from a few feet to 30 or 40 feet thick. It is practically impossible to traverse these areas with heavy truck-mounted exploration equipment in the summer time.

Only when the ground was frozen, were the exploration parties able to enter these areas, and until recently all work was confined to the short period from December to March when the temperature dropped into sub-zero ranges. However, the heavy timber, the extreme sub-zero temperatures, and the lack of suitable living accommodations presented new problems of personnel and equipment. All of these problems were solved in the shortest possible time. Bulldozers were employed to cut trails through the heavy timber and remove snow; personnel was equipped with proper clothing and housing facilities, and all equipment was winterized to insure uninterrupted operation during the winter period.

Reservation or lease commitments in Alberta require a certain amount of exploratory work in a limited time, and this time is often not long enough to explore a reservation in the undeveloped areas during the short winter period, especially if roads and trails to the otherwise inaccessible area have to be built in the same period. Summer operations in the bush and muskeg areas are therefore most desirable, and the year 1950 marks the beginning of the third stage in operations. Several companies have used the past winter months to equip themselves with portable, lightweight instruments and equipment, which are now either carried by hand or mounted on light trailers and sleds and pulled by light caterpillar type tractors over the undisturbed muskeg surface. There is no doubt that the exploration companies will further improve this type of equipment and will thus overcome the difficulties presented by the bush and muskeg country during the summer months.

The striking development of exploration activities in Western Canada is reflected by the rapid increase of geophysical parties which have been employed to carry out such an increased exploration program. The following summary shows the increase during the past six years and the figures listed for each year represent the maximum number of geophysical parties that were reported in Western Canada during the peak month of each year. No specific breakdown with regard to the type of parties was available for the years 1945 to 1948.

GEOPHYSICAL PARTIES

Year	Total	Seismograph	Gravity Meter	Magnetometer
1944	11	7	4	
1945	15			
1946	15			
1947	22			
1948	65			
1949	110	81	28	1
1950	122	96	15	1

Extreme weather conditions of the past winter cut operations to 102 parties by January, but by early May, 1950 the total number had increased to a new high of 122; 77 seismograph parties and 7 gravity meter parties are working in Alberta which is still the most active area in Canada. Saskatchewan, which is now in the first stage of development, reports 16 seismograph, one magnetometer, and eight gravity meter parties. Some geophysical work has been carried out in British Columbia in the past years, but at the present time there are no geophysical parties operating in this area, although a considerable amount of geological work is being carried out. Geophysical work in Manitoba was shut down during the winter months, but has now resumed operation with three seismograph parties. Thus the Western Canada Basin has advanced to one of the world's most active exploration areas, taking second place after the state of Texas which is still the world's most active area.

Shooting tractor winching recording trailer

Expenditures for exploration work have increased tremendously during the past few years as a result of the increase in the number of parties and also in the cost of special equipment required for transport in the northern undeveloped area. Geophysical prospecting is expensive; a magnetometer party may cost as much as $1,500 per month, a gravity meter party may cost from $4,000 to $5,000 per month, and a seismograph party may cost from $11,000 to over $20,000 per month, depending upon the number of special units necessary to move the equipment over the difficult Canadian terrain. Present expenditures for geophysical exploration in Western Canada exceed $1,500,000 per month. However, the known oil reserves in the Western Canada Basin are estimated at over 1,200 million barrels, a large part of which has been located by geophysical exploration. Therefore, the present expenditures for geophysical prospecting are understandable and are well justified considering the tremendous oil potentialities of the extensive area yet to be explored in this large basin.

Recording truck in the muskeg and bush country during winter time. All photographs with this article courtesy Seismograph Service Corp.

Canada's Early Oil History

By J. L. IRWIN

BACK in the early 1700's, some 250 years ago a conversation took place between an Alberta Indian and a Hudson Bay factor which has been recorded.

After traveling a great distance in his canoe, the Indian had disposed of his furs. Asked where he obtained the material with which his canoe was caulked, the Indian said that in the far-distant country where his people dwelt there was a great river flowing between black cliffs. When the sun shone, a black liquid with a strong smell seeped from these cliffs into the river. The Indian filled the crevices of his canoe with this black stuff when it was warm and soft and sticky. Later it became hard and kept the water out. He did the same with the roof of his lodge, and it kept the rain out.

Nor was this all, for in the summertime game appeared to roll in the river flats where these seepages existed so that the black stuff would keep away the flies. Hunting was easy at that time of year along the bituminous sand banks of the Athabaska River.

About 50 years after the Indian's discovery on the Athabaska River, great pioneers such as Alexander MacKenzie, Hearn and Peter Pond passed through this area and reported on these seepages. A century later Dr. George M. Dawson and later Dr. Bell, both of the Dominion government Geological Survey, officially reported on these in technical detail.

Strictly speaking, the first oil well on the American continent was located in 1858 at Oil Springs near Petrolia, Lambton County, Ontario, a year before the famous Drake well at Titusville, Pennsylvania, was brought into production. In 1830, 29 years before the Pennsylvania Drake well, settlers near Enniskillen in the Lambton County, western Ontario, noticed oil in the swamps of that area. It was named "gum oil," and its presence was not welcomed because it retarded growth of vegetation and reduced the value of the land. This was the area that contained Petrolia and Oil Springs, which later became famous.

In 1858, J. H. Williams of Hamilton paid special attention to these "gum beds." He believed that they contained naphtha as in the wells of Baku in Russia. He, therefore, took out sections of the beds, boiled the gum in a retort and produced a light oil. Feeling that the recoveries would become greater at depth, he dug a well below the surface. His deductions proved correct. The lower he went, the greater was his yield. In other words, he dug the first oil well on the American continent.

Others followed his example, and soon there were about a dozen wells excavated at Black Creek near Oil Springs. In 1862 James Shaw, a photographer who had closely followed this development, decided to drill a well by the method of spring pole worked by footpower. It succeeded. At a depth of 165 feet the cap rock was punched, and the well flowed thousands of gallons per hour for a considerable time.

This started an oil boom in which many wells were drilled, some producing as high as 2,000 barrels per day. Lengths of "Scotch casing" were soldered together, similar in appearance to heavy stovepipe, and lowered into the wells. The discovery well before it could be controlled threw oil to the tree tops and spread over the land to a depth of over a foot.

The Dominion government officially gave credit to the discoverer of oil by means of a flowing well as follows: "The first flowing well was struck on the 19th of February, 1862, when Mr. James Shaw of Oil Springs found oil at a depth of 160 feet in what is now known as the 'upper vein.'"

The Dingman wells, first two drilled in Turner Valley in 1914. Photo by H. Pollard, Calgary.

Production was carried out with great waste. Flowing wells after about two years turned to pumpers with water eventually replacing the oil. Among the record producers was the Black and Matheson well which produced at the rate of 6,000 barrels a day for a time.

Cost of sinking one of these early wells was around $1,500, the contract price generally running around $3 a foot for the first 500 feet. Time for drilling covered about three months. In 1864 there were six refineries at Oil Springs. In 1867 the last one shut down due to failure of the crude supply. One refiner stated proudly that he had no man working for him for less than $9 a week!

Petrolia succeeded Oil Springs and maintained Ontario's record as an oil-producing area. According to an article in the *Petrolia Topic*, March 1, 1892, Petrolia was surrounded by thousands of oil wells together with numerous refineries, machine shops, boiler shops and other industrial establishments. The petroleum industry, either directly or indirectly, provided a livelihood for some 20,000 people.

In 1880, twenty-two years after J. H. Williams of Hamilton dug Canada's first oil well, the company he formed, then known as Imperial Oil Limited, built the most modern refinery of that time at London, Ontario, refining Canadian crude oil for the Canadian trade. A complete refinery was built at Petrolia in 1901. A few years later Canadian Oil Company Limited came into being, and the Petrolia refinery became the manufacturing center for the new company's nation-wide operations. Ontario's oil boom lasted from the early 1860's to the early 1900's.

Following the reports from Drs. Dawson and Bell and up to the turn of the century, search for oil and gas in Alberta was limited to isolated tests. Equipment was inadequate and lacked many of the requirements for deep well drilling.

The first discovery of dry natural gas in Alberta dates back to 1885, resulting from a well drilled at Langevin, now known as Alderson, about 40 miles northwest of Medicine Hat. The first well at Medicine Hat, drilled by the Canadian Pacific Railway, came five years later. At a depth of 650 feet a pressure of 250 pounds was obtained. Medicine Hat and Redcliff have now been active producers for 60 years. Pressures are still good, and many industries have long been in operation through the use of this cheap fuel.

Athabaska Landing reported a gas discovery in 1896 at a depth of 1,200 feet. Later the drilling outfit was taken down the Athabaska River, and another well was sunk at Pelican Rapids. At 750 feet a strong flow of gas was encountered which blew the tools out of the hole. Following this the well caught fire and was not extinguished until several years had passed.

Four years later after the first well was drilled, another attempt was made at Pelican Rapids. Three wells in all were sunk, but further development was deferred because of the difficulty of moving heavy machinery into the district.

Bow Island made its appearance as a gas field in 1900, and Viking came on to the scene during the period of the first world war. Sufficient wells were drilled to warrant the laying of pipelines to Edmonton, 80 miles to the west, which was done just after the war came to an end.

Adjoining Viking is Kinsella, an even greater field, which was later explored by Imperial Oil Ltd. in a widespread drilling program. The combined fields with their increased potentials have not supplied gas to the capital city and surrounding area for many years.

A Mr. Baring, of the great banking firm of Baring Brothers of London, investigated the possibilities of obtaining natural gas in the Waterton Park area in 1884. An active part in this venture was taken by a Mr. Fernie, after whom the city of Fernie, B. C., was named.

Drilling started in 1891, the company being known as the Southern Alberta Land Development Co. Ltd. After reaching a depth of 190 feet, artesian water flow forced an abandonment.

In 1903 A. W. Dingman, who later discovered Turner Valley, organized the Calgary Natural Gas Co. A well site was chosen by the late Dr. D. B. Dowling of the Geological Survey of Canada. The well was located in the Sarces Indian Reserve adjoining the city of Calgary. Reaching a depth of 3,400 feet with insufficient gas showings, the well was abandoned. A second attempt was made on the estate of the late Col. James Walker of Calgary. The well was productive and maintained a small yield as late as 1939.

Alberta's first real oil boom resulted from renewed activity in the Waterton Park area in 1898. Inspired by the presence of oil seepages along Kishinena Creek in the South Kootenay Pass close to the Alberta-British Columbia border, Oil City, now a ghost town, came into being. Ten wells were drilled. One showed success, but with lost tools and inadequate equipment the site was abandoned. Another produced at the rate of 20 barrels a day and a small refinery was erected. No casing, however, had been run in the well. Water troubles followed, and a short time later activities ceased in the area, leaving Oil City to its solitude and without its oil. The Waterton Lakes area may yet, however, be included in the list of Alberta's oil fields.

In 1909 Vegreville was tested for oil, and drilling became fairly active for a time. Results, however, were negative. After the first war Wainwright development became intensive. An oil with an 18 to 22° gravity was recovered, but activities did not enlarge. Production from that field to the southeast of Edmonton has continued ever since, but it has not been impressive. Present depths are around 2,200 feet. The drilling of a deep test may possibly change the picture in that field.

The first important discovery of oil in Alberta was made in 1914 in Turner Valley. Since then many fields have appeared, some of major size and importance, but until the arrival of Leduc the old valley produced over 90 percent of Alberta's and Canada's oil. It has been a major field; it still is, and since its first appearance it has recovered over a hundred million barrels of oil.

Turner Valley's initial bid for fame came

Group inspecting Alberta's first oil recovery from Dingman No. 1 in Turner Valley. From left to right: A. J. Sayre, Calgary Colonization Co.; second man unknown; William Pierce, Canadian Pacific Railway; Tappy Frost; R. J. Hutchins, head of the Great West Saddlery Co. in Calgary; Hovis, one of the drillers; R. A. Brown, Sr.; A. G. Graves, secretary-treasurer, McDougall Segur Exploration Co. of Canada, Ltd. Photo by H. Pollard.

when A. W. Dingman, on the advice of Herron and Elder, oil pioneers of that time, decided to test the area. As general manager of the Calgary Petroleum Products Co., which had been organized by Eugene Coste, a Calgary promoter, Mr. Dingman supervised the drilling of the valley's first two wells, Dingman 1 and 2. Oil was found in the shallow horizon above the limestone. First production was not large, but it was oil at last and apparently in commercial quantities. The idea inflamed the imagination of the Calgary people who had just gone through a frantic real estate boom. It was hailed as a successor to real estate—something by which quick and easy money could be made. Real estate offices turned into brokerage concerns over night, and a host of companies was organized. Citizens crowded and stood in line to buy stocks, and in some of the offices clothes baskets were pressed into service as receptacles for cash.

Very few of the promoters at that time had the vaguest idea as to the cost of drilling a well. In addition to this there was very little geological talent available to guide them in selecting drill sites. Technical men to look after engineering problems were scarce. Any man who had trained as a driller, however slight that training might be, could demand exorbitant wages and be regarded with respect.

During this first Turner Valley boom several of the companies drilled wells and obtained modest yields of oil. Small topping plants were built and gasoline was marketed from them. The saving of samples from structure penetrated was carried out by only a few of the companies. Because of this, knowledge of sub-surface conditions was most limited. One bright newspaperman, untrained as a geologist, recognizing this failing, examined and recorded a few of the well logs. He was able to distinguish sandstone from shale and to record the general appearance of drill cuttings.

Ten years passed with desultory activity. Calgary Petroleum Products Co. had been reorganized and had become the Royalite Oil Co. Then in 1924 Royalite No. 4 well was drilled, and the second milestone of the Valley's history appeared. Royalite 4 penetrated the Lower Cretaceous sands where other wells had obtained some production, then on through the dense black Fernie shales, in which there was no porous reservoir rock, until it reached the Palaeozoic limestone (Madison).

Hopes died when this happened, for elsewhere in the province this formation had proved sterile except for water. Reaching 280 feet in the lime, it was decided to abandon, but another 10 feet were drilled. At 290 feet there came a burst of gas. Tools were pulled and the valve closed on the top of the well. A pressure gauge showed a rise of 100 pounds a minute. The crew retired from the derrick. Fifteen minutes later the casing started to rise and went to the crown of the derrick, later settling back as gas came up around.

The well caught fire and blazed fiercely for several weeks before being extinguished. Tests showed distillate oil in the gas, and when a separator was installed, it was found that the well was making 500 barrels a day, worth $4.40 a barrel.

The flare from Royalite 4 came to be known as Hell's Half Acre. It burned for six years. In that time a total of 900,000 barrels of oil was recovered, valued at over $3 million.

The third milestone came in 1929 when the first well of the Home Oil Co. came in as a prolific producer with 700 barrels per day. By this time development was proceeding more cautiously, and samples of drill cuttings were systematically examined. It was then believed that there still remained a large percentage of oil in the gas after the latter had passed through the separator. Because of this an absorption plant was built by Royalite for recovery of additional gasoline from gas already processed by separators. The results were extremely successful and remunerative from the start.

For the first half dozen years and more, following Royalite No. 4, no restriction had been placed on production. The general idea had been to get all possible for the present and let the future look after itself. There came at last the much-needed organization of a conservation board and the adoption of a more orderly and economic system of operation.

The fourth and greatest milestone of Turner Valley's history was established on June 16, 1936, when the discovery well was completed on the west flank of the Madison structure which produced crude oil instead of wet gas. The late R. A. Brown Sr., president of Brown, Moyer, Brown of Calgary when that company was formed following this initial success, was responsible for the discovery which was to mean so much to the oil industry of Canada.

It had been Mr. Brown's belief and the belief of a few others that the west flank would produce crude oil. There was much skepticism concerning this, even from technical men. Determined to make this test, Mr. Brown put everything he had into this venture and was helped by the British American Oil Co. The well came in at a depth of 6,828 feet in the limestone with an open flow of around 1,000 barrels per day.

This ushered in the most lucrative period of Alberta's oil history up to that time. Resulting from this event, in two year's time the average 1¼ million barrels recovered annually jumped to nearly seven million. In 1942 it exceeded 10 million. Then came the expected decline. The price had to be paid for the riotous years following Royalite No. 4. In spite of its gradual decline, Turner Valley produced 4,304,063 barrels in 1949. According to expert opinion, it is expected to stay in the major class for at least another ten years, possibly twenty.

The establishment of crude oil production in Turner Valley in 1936 must always stand out prominently as an event of the most significant importance. In one sense it may even be regarded as the greatest event in Alberta's oil history, for it provided a definite incentive for the exploration program that followed a decade later, which led to Leduc, Woodbend, Redwater, Golden Spike and many others.

It was the faith and resolution of R. A. Brown Sr. which produced the experiment, and it was the success of that experiment which produced the program of intense activity in exploration that in a few short years has made Alberta, and therefore Canada, a power today in the world of oil.

Acknowledgment: The author is indebted to Canadian Oil Companies, Ltd., and to Imperial Oil Ltd. for much of the historical data used in this review of Canadian oil history.

Crude discovery well drilled on the Turner Valley flank in 1936 by the late R. A. Brown with British American Oil Co. backing.

CRUDE DISCOVERY WELL
TURNER VALLEY ROYALTIES No.1 WELL
COMMENCED DRILLING WITH STANDARD EQUIPMENT APR 16 1934
CHANGED OVER TO ROTARY EQUIPMENT FEB 11 1936
CONTACTED LIMESTONE AT 6396 FEET
DRILLING COMPLETED JUNE 13, 1936
TOTAL DEPTH 6828 FEET
BROUGHT INTO PRODUCTION: JUNE 16, 1936
INITIAL PRODUCTION: 850 BARRELS DAILY
FORMATION MARKERS
ELEVATION 4241 FEET
CARDIUM SANDSTONE 3570
HOME SANDSTONE 5860
BALHOUSIE SANDSTONE 6050
LIMESTONE CONTACT 6396
TOTAL DEPTH 6828
DEPTH IN LIMESTONE 432
TURNER VALLEY ROYALTIES LIMITED
232-LOUGHEED BUILDING
CALGARY, ALBERTA

First Canadian "Gusher" blown in January 31, 1862, near Victoria, Enniskillen Township, Canada West.

Loading vessels in the St. Clair River with Oil floated down Bear Creek in barrels, 1862.

First oil exchange in Canada at Petrolia.

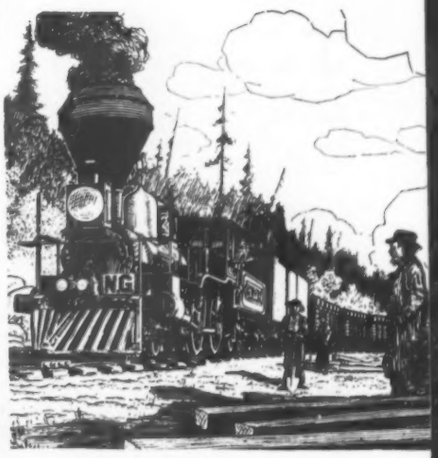
Plank toll roads were laid to provide outlets for oil from the Enniskillen Oil Springs, Petrolia Field, in the early Sixties.

Jerker lines pump over 7,000 barrels a month in the oil springs area after 50 years operation of this field.

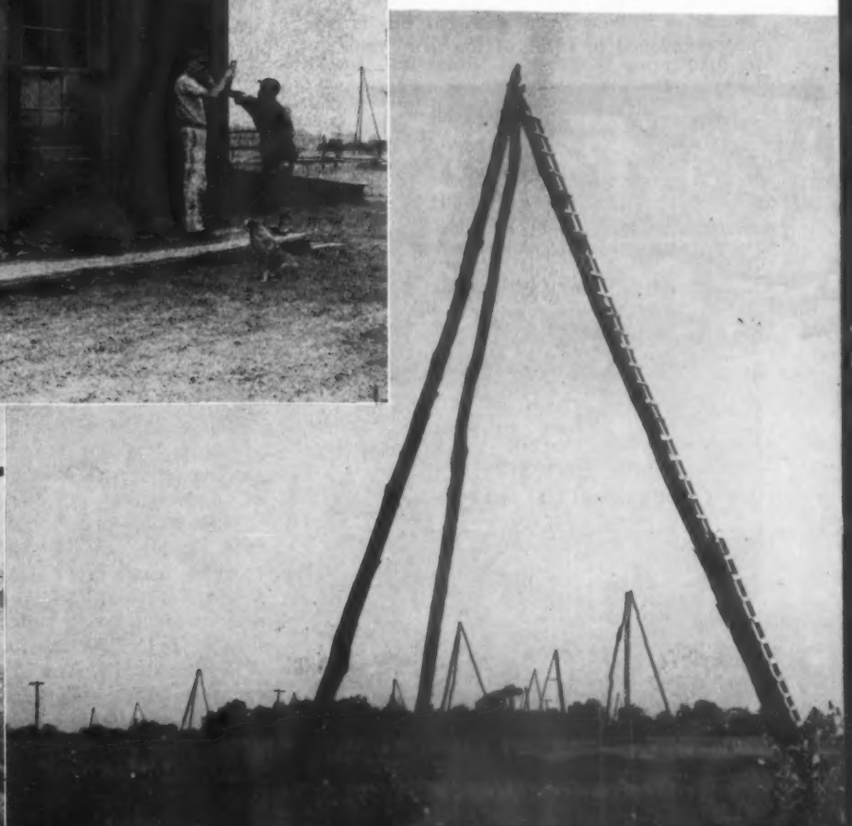
Photos courtesy Imperial Oil Ltd.

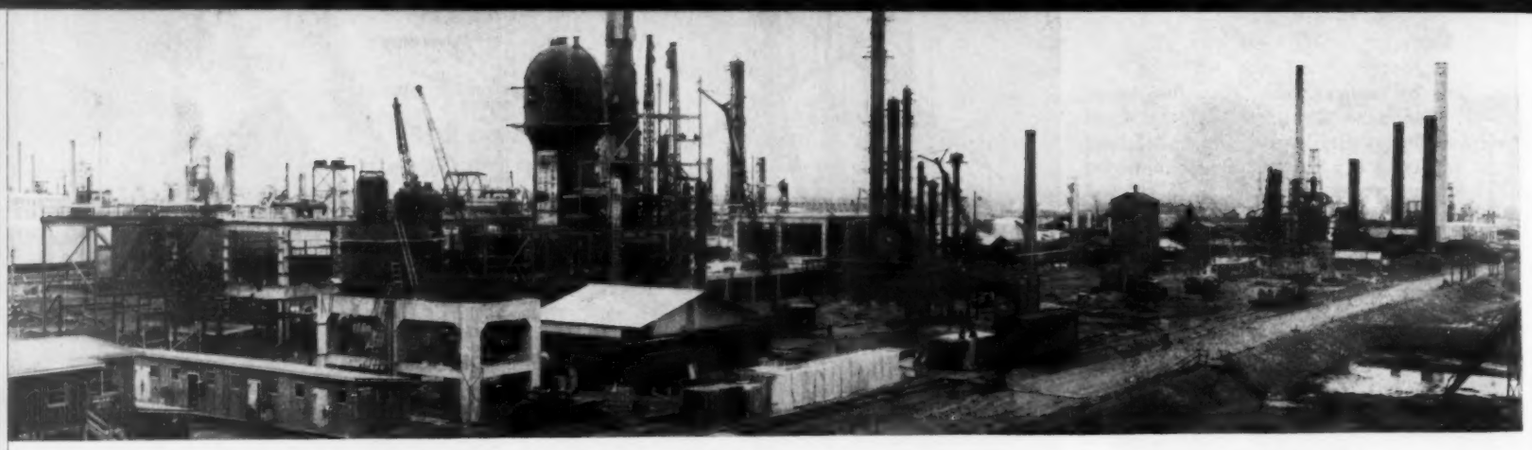
First pumping station in North America.

Trainload of barreled oil leaving Wyoming, Canada West, first rail shipping point for the Enniskillen Oil Field, 1862.



Clusters of tripod derricks such as these still mark wells in the old Ontario oil fields which still yield a few barrels a day.





Status of building operations on Shell's new cracking unit on May 3, 1950.

Shell Increasing Refinery Capacity At Montreal

THE Shell group of companies began operations in eastern Canada in 1912 by the installation of a terminal at Montreal for the importation of gasoline from Borneo and a bunkering station for St. Lawrence shipping. In 1913 Shell of California began distributing to Canadian markets in British Columbia, but it was not until the close of World War I that Shell Oil Co. of Canada Ltd. began developing its extensive distributing system in the provinces of Ontario and Quebec.

Operation of the eastern and western branches has now been combined, and the company is currently engaged in a major expansion program designed to enable it to serve the growing postwar market. The program involves a stepped-up exploration campaign and the expansion of refinery facilities by nearly fifty percent.

For the past four years Shell has been making a detailed examination of three million acres in New Brunswick, but this is being abandoned in favor of the more promising leases in western Canada where Shell began exploratory work in 1941. In 1942 an office was opened by Shell in Calgary and drilling operations begun. These activities resulted in the discovery of the Jumping Pound field in 1944. Today Shell is operating a large geophysical and field geological campaign, accompanied by extensive drilling. Some of this drilling is centered in Calgary, but considerable drilling is also being done in the far northern territory. Shell holds or is directly interested in several million acres of oil leases, permits and reservations in the provinces of Alberta, Saskatchewan and British Columbia.

Shell operates two refineries in Canada, one at Montreal on the River St. Lawrence, supplying its eastern markets, and the other at Shellburn, Vancouver, in British Columbia, supplying the Canadian Pacific coast market. The 7,000-barrel Shellburn refinery, which is strategically located on Burrard Inlet near Vancouver, was built in 1932. New cracking and polymerization units were built in 1946. This refinery has excellent docking facilities for the deep sea tankers which bring its crude oil requirements from California and South America.

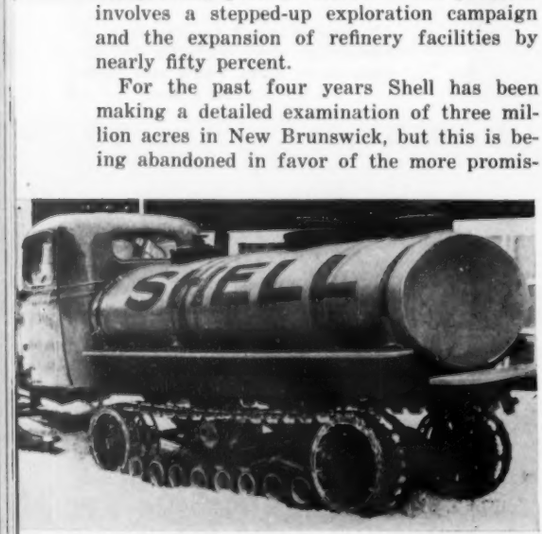
When first erected in 1933, Shell's eastern refinery at Montreal had a capacity of 5,000 barrels daily. Capacity since has been increased to 15,000 barrels by the installation of a topping unit and a revamping of the Dubbs cracking unit. New construction now under way will add catalytic cracking and raise crude charging capacity to 25,000 barrels daily.

The enlarged refinery, expected to be in operation late this year, will consist of two topping units with a combined intake capacity of 25,000 barrels per day, a vacuum flashing unit, a 10,000-barrel fluid catalytic cracking unit, thermal cracking and reforming, a gas recovery plant, propylene and butylene polymerization plant, light ends treating plant, a solutizer treating unit for cracked gasolines, and clay treating for various naphthas. A very modern system of in-line blending of components for motor gasoline and fuel oil, including automatic leading, is being installed, which should result in considerable economy as well as increased uniformity of products. In addition the new refinery facilities will include 750,000 barrels of new tankage, enlarged steam plant, new maintenance shops and other services.

The refinery will process Venezuelan crudes with low to medium sulfur content. However, corrosion protection to permit running sour crudes has been provided.

Shell of Canada formed Deep Sea Tankers Ltd. in 1947 as a shipping subsidiary with three T-2 tankers to bring in crude from foreign producing areas. Another subsidiary, Shell Canadian Tankers Ltd., makes use of the excellent inland waterways of Ontario and Quebec on which Shell has 16 marine terminals strategically located to serve these two provinces. In a 7½ month navigation season these tankers deliver enough petroleum products to the marine terminals to enable them to fill their customers' requirements throughout the winter. Shell of British Columbia operates a coastal tanker which not only makes deliveries to the marine terminals but also makes regular 700-mile trips along the British Columbia coastline, selling products direct to the consumers in the many small communities, logging and fishing camps.

Shell recently has streamlined its marketing organization in eastern Canada by reducing the number of divisions to two, although the marketing territory has been enlarged. The western Canada operation now has been completely integrated with that in the east and operates as a division. In addition to the 16 marine terminals mentioned previously, Shell operates 75 bulk stations. Large distribution warehouses are located at Montreal and Toronto. These are equipped for blending and packaging lubricants and other products. The company now employs about 2,300 persons in carrying on its widespread operations.



A snowmobile used by Shell to make winter deliveries in Quebec province.

One of Shell's newest type retail stations.

W. M. K. Ash, President of Shell Oil Co. of Canada

S/S Britamoil of the British American Great Lakes tanker fleet opposite the company's refinery at Clarkson, Ont.

British American Expanding Rapidly

IN the 44 years since it first was organized by A. L. Ellsworth and Silas B. Parsons, British American Oil Co. has become the second largest oil company in Canada. Its products are sold from the Atlantic to the Pacific in all ten provinces. It is a completely integrated organization with its own production, pipelines, natural gasoline plant, refineries and tankers.

A year after the company was organized to sell kerosene and axle grease it purchased a refinery site and began the erection of a refinery at Toronto. The 1907 plant consisted of two cheesebox stills. In 1909, with a Dominion charter, it spread into Quebec where it now has its largest refinery. Invasion of the Prairie Provinces began in 1920 followed a decade later by development of markets in the Maritimes and in 1945 by entry into the Pacific coast region.

To insure an adequate supply of raw material for its growing markets B-A organized a producing subsidiary in the United States in 1925. When the Oklahoma City field came in B-A had substantial acreage which has since produced some 50 million barrels of oil. Another big strike was in the Steamboat Butte field in Wyoming. It now produces crude from 450 wells in ten states. Production in 1949 totaled 4.5 million barrels and United States reserves at the end of the year were estimated at 51 million barrels.

The company has been an active developer of production in Canada as well as in the United States. In 1936 it financed the drilling of a wildcat well in Turner Valley which resulted in the development of Canada's greatest source of oil until Leduc. The field now has produced more than 100 million barrels of high gravity oil. Outside of Turner Valley B-A has been active in a number of areas. It has leases on 128,000 acres and reservations on 1,325,000 additional acres in the west. It recently acquired reservations in the Peace River area and in British Columbia where geophysical surveys are to be made. Studies also are in progress on leases in Manitoba and Saskatchewan. At the end of 1949 the company had $19 millions invested in Alberta and was operating or held interests in 54 wells and eight more proven drilling sites at Redwater and Leduc.

Following development of the Turner Valley field B-A built a 7,200-barrel refinery at Calgary, Alberta, and a 6,000-barrel plant at Moosejaw, Saskatchewan, to supply its western outlets. The recent development of new production in the prairies has convinced the management of the company that enough crude is in sight for a further expansion of its manufacturing facilities in the west. Consequently construction has been undertaken of a 6,000-barrel plant at Edmonton. This new refinery will be equipped with a fluid catalytic cracking unit for the production of high octane motor fuel. It will be ready for operation early in 1951.

The company's largest refinery is located at Montreal. It was originally completed in 1931 as an 8,000-barrel plant. In 1938 capacity was increased to 17,000 barrels and since the close of the war capacity has been almost doubled again. On May 26 Hon. Robert H. Winters, Canadian Minister of Resources and Development, dedicated the new facilities which include a topping and decarbonizing unit, first of its kind in Canada, a fluid catalytic cracking unit and a catalytic polymerization unit. Plant storage capacity was increased to 4.5 million barrels. The plant supplies most of the company's outlets in Eastern Canada. The 10,000-barrel Clarkson, Ont., plant, built as a war project, handles the central area consumption. It specializes in lube refining with its recently built propane deasphalting plant. Throughput of the four refineries in 1949 was 13.5 million barrels. By 1951 the plant capacity will be up to 20 million barrels per year.

B-A has a 20 percent interest in the Portland-Montreal pipeline built during the war to help supply Canadian refineries with crude. Capacity of this line is being doubled now. The new Edmonton refinery will be served by a 10,000-barrel pipeline being laid to the Redwater field.

In addition to its pipelines B-A employs a fleet of 14 tankers of which six are owned by the company. Chartered ships bring crude from Texas, Venezuela and the Middle East. Products are delivered by tankers to terminals on the St. Lawrence and Great Lakes waterways systems.

B-A retail outlets exceed 6,500 and 1949 product gallonage was approximately 600 million gallons. This was three times as large as the sales record for 1939.

British American is predominantly owned by Canadians. Of its 3,130 shareholders about 97 percent live in Canada. Average individual holding is 150 shares and no individual group has control. Since its inception B-A has never missed a dividend payment. Currently $1 yearly is being paid on the common and 3.75 per cent on preferred.

William K. Whiteford, president of British American Oil Co.

British American's Montreal East refinery which has been increased in capacity to handle 32,000 barrels of crude daily

Montreal works of McColl Frontenac Oil Co., Ltd.

McColl-Frontenac Expansion Nears Completion

ROOTS of the McColl-Frontenac Oil Co. Ltd. go back more than 75 years to 1873 when McColl Ltd. was formed to sell petroleum products in Canada. Frontenac Oil Refineries Ltd. was organized as a separate company in the mid-twenties of the present century, and the present company was incorporated in 1927.

Today the company is a completely integrated organization producing, transporting, refining and marketing a full line of products. With 14 marine terminals and 200 bulk plants, McColl-Frontenac distributes throughout Canada. Three lake tankers serve the company's refineries at Toronto and Montreal, supplementing the fleet of tank cars and trucks. In addition crude is brought in by chartered tankers from the company's producing properties in Trinidad and elsewhere.

In common with other refiners in Canada, McColl-Frontenac has been expanding its refinery operations since the war to keep pace with the rapid growth in demand. In 1946 the company began the expansion of its Montreal works, which then had a capacity of about 18,000 barrels daily crude oil. The equipment consisted of a two-stage crude stilling unit, a combination thermal cracking and visbreaking unit, a recycle gas oil cracking unit, together with polymerization and treating equipment. The expansion program, which is now almost complete, has increased the capacity of the refinery to about 40,000 barrels daily crude.

The first step was undertaken in 1945-46 with the construction of a new 40,000-barrel crude still. This consisted of a three-cell heater, fractionating tower and side stripper, together with all the auxiliary equipment. The former crude stilling equipment was converted to a pressure flashing unit in 1947 and was designed to handle the topped crude produced on the new crude unit. The operation of the pressure flashing unit has two objects; first, to produce catalytic cracking unit feed stock and, second, to reduce the amount of topped crude to be handled by visbreaking equipment. The charge to the pressure flashing unit has recently been about 18,000 barrels daily topped crude, from which 40 to 50 percent gas oil is produced.

In 1948 a fluid catalytic cracking unit, which was designed and erected by the Canadian Kellogg Co. Ltd., was brought on stream. The cat unit, which was to use either synthetic or natural catalyst, has been operated at about 15,000 barrels daily fresh feed. The unit is equipped with a Cottrell precipitator, an outside catalyst stripper and a gas recovery section.

Following the start-up of the cat cracker, the vis-breaking and thermal cracking unit was operated on a charge of pressure-flashed topped crude and catalytic cycle gas oils. It was noted that the vis-breaking unit was producing a considerable quantity of gas oil which was being thermally cracked along with the catalytic cycle gas oils. In order to reduce the load on the thermal cracking equipment and to make more catalytic charge stock available, the vis-breaking equipment was segregated from the gas oil cracking section of the combination unit. The vis-breaking unit now consists of two heaters in parallel, a soaker and a low-pressure flash tower. The charge to this unit has been about 10,000 barrels daily pressure-flashed, reduced crude, producing approximately 50 percent heavy gas oil for catalytic unit feed stock. The gas oil cracking section of the combination unit is now used for selective cracking of the light and intermediate catalytic cycle gas oils. The operation has proved successful with the unit running recently at a fresh charge of about 4,500 barrels, producing a high quality gasoline, thermal cycle gas oil and a low viscosity residual fuel oil.

During 1947-48 the 2,000-barrel daily recycle gas oil cracking unit was converted to a 3,400 barrel naphtha reforming unit. The only alterations were to the trays in the vessels and the flow through the heater. The equipment has operated satisfactorily when reforming to approximately 80-percent C_4 retention naphtha.

In 1948 a new polymerization unit was erected, using exchanger type reactors holding 5,600 pounds each of UOP catalyst. The unit is designed to operate on a mixed propylene-butylene feed stock and currently has produced about 1,200 barrels daily true polymer.

To take care of the increased utility requirements in the enlarged refinery, a new boiler house was constructed containing feed water treating facilities and three 55,000 pounds per hour steam generators operating at 250 psig. The boiler house also contains facilities for emergency electrical power supply, emergency air and firewater pumps. Cooling water facilities were enlarged to provide 40,000 IGPM from the St. Lawrence River, which flows past the refinery dock. Tankage was increased by 1,100,000 barrels between 1947 and 1949 to take care of the increased refinery capacity.

New treating and sweetening units are being constructed to handle the total gasoline and light-burning oil production. A new main transfer pumphouse is being built to handle the pumping operations of the refinery. A large modern office building was constructed and the former office revamped to provide additional laboratory facilities.

The M.V. John Irwin employed by Canadian Oil Companies, Ltd., to supply its marine terminals at strategic points on the Great Lakes.

White Rose Sales Double in Five Years

CANADIAN Oil Companies, Ltd., is a Canadian company, in fact as well as in name, being over 99 percent owned in Canada and operated 100 percent by Canadian personnel. The company conducts business throughout Canada, with the exception of the Provinces of British Columbia and Newfoundland, as a refiner and marketer of petroleum products.

The origin of the company goes back to the turn of the century when several independent companies amalgamated and formed the original Canadian Oil Company, Ltd. In 1908 the assets of this company were purchased by the National Refining Co., of Cleveland, Ohio, and Canadian Oil Companies, Ltd. was incorporated at that time. In 1938 the interest of the National Refining Co. was acquired by a Canadian group who have retained control up to the present time.

The growth of the company during the past ten years has been consistent throughout, and in the past five years sales have increased from 80,307,762 gallons in 1944 to 130,829,382 gallons in 1949, and in dollar value from $17,414,467.00 in 1944 to $33,818,436.00 in 1949.

The company's products are marketed under the trade name, "White Rose," by approximately 3,500 retail dealers throughout Canada, including 300 company-owned service stations. The company operates approximately 150 branch warehouses and six marine terminals, four of which are on the Great Lakes. The other two, at Montreal and Quebec, are of sufficient size to accommodate ocean-going tankers. The company owns a complete refinery at Petrolia, Ont., and a crude oil and gasoline storage terminal at Froomfield, Ont., on the St. Clair River, connected with the refinery by the company's own pipe line.

The administration of the company is carried on from its Head Office at Toronto, Ont., located at 204 Richmond Street, West, and from seven divisional offices across the country.

Directors of the company are: P. A. Thomson, Chairman; W. H. Rea, President; Gordon F. Perry, Vice President; Aubrey Davis, John W. McKee, A. J. Nesbitt, D. P. Robinson, E. G. Smith, W. Dent Smith.

The company is presently constructing in Montreal, Que., a modern lubricating oil blending and grease manufacturing plant which will embody all the latest developments for the manufacture and blending of oils and greases. This plant will be in operation in 1951.

To move products on the Great Lakes the company owns a 259 foot motor type tanker, the "John Irwin," which it acquired in 1945. This vessel has a carrying capacity of 27,000 barrels. It has also acquired a five percent interest in the Interprovincial Pipe Line which will move crude oil from Western Canada to Superior, Wisconsin, the eastern terminus of the line.

A Canadian Oil Companies station at Montreal with spectacular sign surmounting the modern-type sales unit.

Large Capital Investments Required by Imperial

DEVELOPMENT of its properties in western Canada permitted Imperial Oil Ltd. to increase its crude production 188 percent in 1949. Production in 1948 was 2,684,000 barrels and in 1949 it rose to 7,739,000 barrels. The increase allowed the company to keep its imports of foreign oil about in line with 1948 despite an eight percent rise in sales.

Financial requirements have been heavy to meet the company's exploratory and development program in the west plus the normal investments necessary to keep pace with increasing demand. In the past four years capital expenditures have totaled $118.7 millions which is equal to about 52 percent of the company's capital assets before reserves and more than capital assets after reserves at the close of 1949. Expenditures for plant and equipment last year totaled $34.2 millions compared with $36.6 millions in 1948 and $27.2 millions in 1947.

Imperial had spent some $23 millions in prospecting the prairies before its Leduc discovery in 1947 and although exploratory drilling has been continued since that time a far greater financial burden has been imposed by development drilling. In 1946, for example, Imperial drilled 54,704 feet in development wells in Alberta. After Leduc this increased to 159,791 feet in 1947, to 679,747 feet in 1948 and to 959,607 feet in 1949. Meanwhile exploratory drilling increased from 87,403 feet in 1947 to 179,119 feet in 1949.

Full effect of the drilling campaign of the past three years will not become fully apparent until the 1,150-mile Interprovincial Pipeline is completed from Edmonton to Lake Superior so that western crude can be economically refined at Sarnia and products distributed through the central part of the Dominion. Thus far the company has had to restrict its production from completed wells to the capacity of near-by refineries. This capacity has been increased but not enough to completely supply consumers on the prairies. First step by Imperial was to buy the 6,000-barrel wartime refinery at Whitehorse, Alaska, and move it to Edmonton. The total cost was about the same as that of a new plant but it was possible to begin operations much sooner. Since then the Edmonton plant capacity has been raised to 16,000 barrels, throughput at Regina has been increased and work has been begun on a new 10,000-barrel plant at Winnipeg which will cost $10 millions.

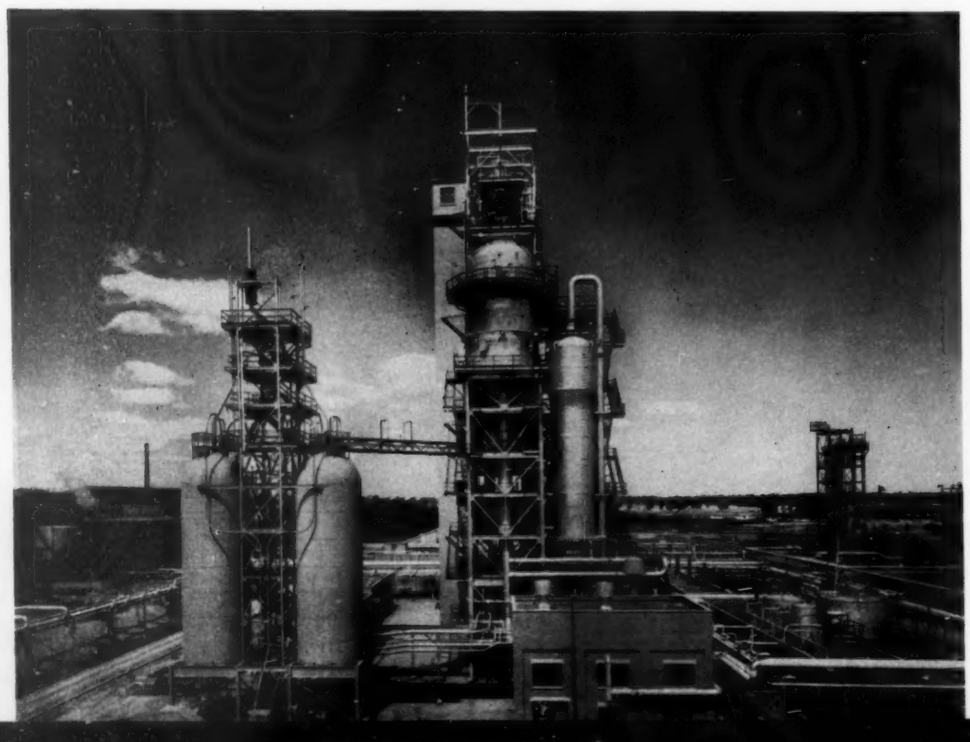
Imperial's net crude reserves at the close of 1949 have been estimated to exceed 700 million barrels compared with 323 million barrels at the end of 1948 and only 19 million barrels in 1945.

Refining operations of the company extend from coast to coast and from the Great Lakes to the Arctic Circle. Aggregate capacity of the eight plants is 165,700 barrels per day and daily average throughput in 1949 was 148,545 barrels, an increase of nine percent over 1948. Smallest Imperial plant is the 1,000-barrel skimming plant at Fort Norman, within 90 miles of the Arctic Circle, which is supplied by local crude. Largest is the 52,000-barrel plant at Sarnia, Ont., which now draws almost all of its crude supply by pipeline from the United States and about one percent comes from fields in Ontario. Eventually this plant will be largely supplied by western Canadian fields. On the west coast the 12,000-barrel plant at Ioco, B. C., obtains virtually all of its crude from California. The 22,000-barrel plant at Imperoyal, N. S., and the 37,500-barrel plant at Montreal are supplied from Latin America and the Middle East.

Pipeline facilities of the company include a 40 percent increase in the Portland-Montreal line which was built during the war to conserve tanker tonnage and is now being enlarged. Imperial Pipe Line Co. Ltd., extended its gathering facilities in the Leduc-Woodbend, Redwater and Golden Spike areas in 1949. Oil handled increased threefold during the year to 12.9 million barrels. Trunkline movement to Edmonton increased nearly eightfold to 4.3 million barrels. The Transit and Storage line to Sarnia handled 16.7 million barrels.

With Imperial still largely dependent on foreign crude for its plants the company's marine department handled 65.9 million barrels of oil through owned and chartered boats. The Imperial Oil Shipping Co. owns nine ships of 133,163 deadweight tons. In addition Imperial's marine department operates 14 vessels, totalling 40,826 dwt. Two new 629-foot lake tankers are being built for chartering to Imperial and will carry crude from the head of Lake Superior to Sarnia when the new pipe line is complete. Tanker deliveries of products to terminals on the Great Lakes and the St. Lawrence are supplemented by a fleet of 5,729 tank cars which carried 163,000 loads in 1949.

Imperial sells its products in all parts of Canada, in mining areas of the far north and on both coasts. Sales in 1949 totaled 56 million barrels. Increase over 1948 was four million barrels or eight per cent. The company's refineries were unable to supply its entire demand last year so 4.5 million barrels of products was imported. Marketing facilities of the company include 1,477 wholesale stations from which products are distributed to about 10,000 retailers, industrial consumers and the farm trade. The company owns 840 retail stations which are leased to private operators.



First catalytic cracking unit to be built in Canada was this 11,000-barrel unit installed by Imperial at Montreal. ←

George L. Stewart, president of Imperial.

...Background for high octane fuels

Today, thanks to the fluid cracking techniques used in modern refining operations, it is possible to produce high octane fuels to match the requirements of engines of high compression ratio. Contributing vitally to this progress has been Cyanamid's development of AEROCAT* Ground and Microspheroidal Synthetic Fluid Cracking Catalysts.

Behind these efficient products, *continually in expanding production to meet increasing requirements,* are Cyanamid's scientifically equipped units, extensive research facilities and the experience and skill of our highly trained technical staffs. *All* of these are at your service to help you select and use the catalyst best suited to your individual needs.

Other Cyanamid specialties for the Petroleum Industry include AEROLUBE* Additives for regular, premium and heavy-duty motor oils . . . AERO** Specialty Catalysts for various chemical processes . . . Gasoline Dyes and Drilling Mud Chemicals. Literature and samples of these products are available on request. Write today.

*® **Trade-mark

AMERICAN *Cyanamid* COMPANY

PETROLEUM CHEMICALS DEPARTMENT, DIV. B7

30 Rockefeller Plaza, New York 20, N. Y.

WHEN PERFORMANCE COUNTS . . . CALL ON CYANAMID

For further information in Europe, consult Cyanamid Products, Ltd. Bretteuham House, Lancaster Place, London W. C. 2, England.

Oil Companies of Western Canada

ALTHOUGH the great development of the oil industry in western Canada has been a comparatively recent growth, the companies actively interested in this area already are numbered in the hundreds. The activities of many of these have not yet been advanced beyond the preliminary state, and the list is too long to be included here. There are, however, a number of companies and groups that have been active over a fairly long period and that have contributed substantially to the discoveries and expansion that have attracted interest and attention to the Prairie provinces. A few of these are described briefly in the following paragraphs.

The third great milestone of Turner Valley's history was created in 1929 by the then newly-organized Home Oil Company Limited, of which James R. Lowery is president, when it brought into production its first well as a major producer with 700 barrels of high gravity oil per day. In the 21 years of the company's history many millions of dollars have been spent in the acquisition and development of its reserves. This has been more than paid for by production revenue.

Of the ten million dollars expended in Turner Valley's development, about 95 percent has been paid out of revenue. Redwater, in spite of production restrictions, is expected to recover all expenditures for that field by the close of 1950. Leduc revenue over expenditure shows a surplus at the end of 1949 of $750,000. The annual report for this year stated that there were 57 producing wells and interests in 51 others.

President Lowery of Home Oil in his report makes reference to the gross production since 1938, which totalled around $24 million, $20 million of which came from Turner Valley. Dividends for the past eight years reach a total of $3,532,000, which includes $980,000 in 1949. Production for that year was 1,807,218 barrels.

The famous Home Millarville No. 2 well in north Turner Valley is still in production after a performance of many years. It has been and still is the largest producer in Canada, having yielded over 1.5 million barrels to the end of 1949. The four largest producers of the valley belong to Home Oil. In 1949 the company's oil recovery total from Turner Valley was still at its largest source of revenue. Leduc, close behind in second place, will assume top position in 1950.

Royalite Oil Company Limited, formerly a subsidiary of Imperial Oil Limited, changed its status over a year ago and became one of Alberta's great independent companies under the presidency of S. F. Heard. Its wholly-owned subsidiaries are the Madison Natural Gas Company and Valley Pipe Line Company. The twenty-ninth annual report for 1949 showed the rapid expansion made by the company in its first year as an independent.

Royalite came into being a few years after the discovery of Turner Valley in 1914. In 1924 it made history in the valley with the completion of its famous No. 4 well, the first to enter the Madison limestone in that field. It produced wet gas for six years, the total of which exceeded 900,000 barrels valued at $3 million.

Operating revenue for 1949 totalled $6,864,947, an increase of $678,000 over 1948. Capital expenditure was $5,403,000, which included $4,356,000 for the acquisition and development of 800 acres of proven oil area in the Redwater field. Dividends showed a slight increase, the company's profit position was definitely maintained, and holdings in oil leases and reservations in the three western provinces were considerably increased.

S. F. Heard

The acreage acquired in Redwater, and since developed, proved a highly profitable undertaking. Production last year from this district alone totalled a gross of $1,013,162. In February of the present year the company acquired a 50-percent interest in an additional 480 acres of proven oil land at Redwater in which several wells have since been placed on production. By the end of May of the current year Royalite owned or had interest in 32 producers in Redwater; in Turner Valley it had 65 crude and 51 gas wells. Development is being actively carried out in the three western provinces of Saskatchewan, Alberta and British Columbia, which includes test well drilling on Graham Island on Canada's Pacific coast.

Federated Petroleum Limited came into being in 1936. It was founded by R. A. Brown Sr., just two years after his discovery in Turner Valley of crude oil in the Madison limestone by the successful completion of the famous Turner Valley Royalties well. It was the greatest and most important event in the valley's history and paved the way for all that is happening in Alberta's oil industry today. R. A. Brown Jr. is now president of the company.

In November 1949, through purchase from Imperial Oil Limited, the company secured a majority interest in Foothills Oil and Gas Company Limited and Lowery Petroleums Limited, giving it an interest in 54 producing wells in Turner Valley.

R. H. Brown, Jr.

Federated Petroleums and associated companies in 1949 produced 750,000 barrels of crude showing a combined net cash gain after payment of taxes of around $1,250,000. Federated and Shell Oil Company of Canada Limited were responsible for early drilling at Jumping Pound which established that field as a major Canadian gas area.

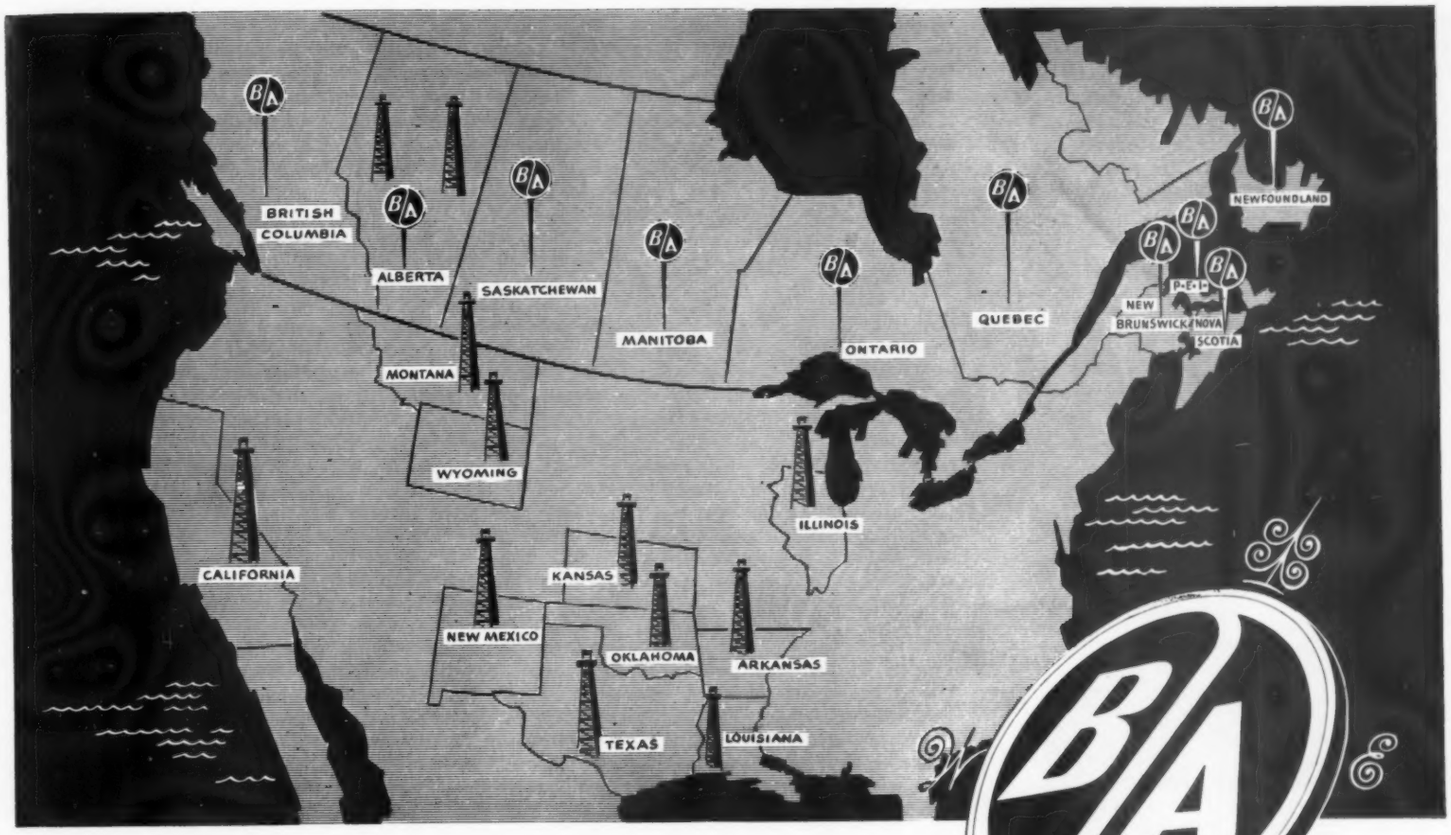
In association with other companies, Federated acquired on May 11 of this year a half section of proven oil land in the Redwater field. Producing wells have already appeared on these sites. In addition to drilling on established land, the company is conducting an exploration program in both the plain and foothills areas.

Pacific Petroleums Limited, of which Frank M. McMahon is president, was incorporated in 1939 with a British Columbia charter as successor to West Turner Petroleum Limited and British Pacific Oils Limited. Pacific Petroleums is one of the most active of the independent companies. Its interest in oil development is expressed in its extensive reservation of acreage in the four Western provinces.

Frank M. McMahon

Four seismic parties and four surface geology parties are employed. In addition to its 44 producing wells in the Redwater field at the time this is written, eight more locations are waiting to be drilled. In Redwater four drilling rigs are steadily employed.

Subsidiary companies of Pacific are Atlan-



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tic Oil Company Limited, Peace River Natural Gas Company Limited and Oil Ventures Limited. Interests are also held in several other companies. The growing strength of the company is indicated by the rise of its stock from a low in 1944 of forty cents to a high of $6 in the current year.

Anglo-Canadian Oil Company Limited was incorporated in November 1934. Acting independently through subsidiaries or as a team with Home Oil and Calgary and Edmonton Corporation, Anglo-Canadian has been for many years active in oil development in western Canada. Its president is H. R. Milner, K.C.

H. R. Milner, K. C.

The company is at present interested in 78 producing wells in Turner Valley, Leduc, Woodbend and Redwater. It has a controlling interest in the salt plant at Elk Point, 30 miles north of Vermilion, where it has its own gas wells to supply fuel and power. The plant is in operation, and its products are distributed throughout the west.

Anglo-Canadian, as one of the largest of Alberta's independent companies, more than doubled its gross revenue in 1949 due to intensive development through the year. Gross revenue from production, after payment of royalties, last year totalled $1,414,925, to compare with $686,855 in 1948. The year was marked by a noteworthy record in successful completion of wells. On a 50-50 basis with Home Oil, 12 wells were brought in on 480 acres at Redwater. Woodbend completions numbered 16. Active development continues in proven areas, and exploratory work is being conducted over a wide area in the province.

The Continental Oil Company of Canada Limited was incorporated in 1936 with an Alberta charter. The company has a total of 20 producing wells, one in Turner Valley and 19 in the Leduc-Woodbend field. Production from the latter comes from eight wells in the Lower Cretaceous and 11 from D2 and D3 structures of the Devonian. G. Harris Sr. of Calgary is its chief executive.

Continental's development of the Lower Cretaceous area of Leduc made an outstanding contribution to the activities of that field. Royalty interests are also reported from 103 Turner Valley wells. There are 18 offset drilling locations in the valley and 12 in Leduc. Interests are also held in other fields of the province.

National Petroleum Corporation Limited, which is headed by S. M. Zandmer of Calgary, attracted attention in the earlier part of the current year with its development of the Spring Coulee area in southern Alberta, where it has a reservation of about 33,000 acres. The interest came from discovery of oil in its National Spring Coulee-Malmberg No. 1 well at a depth of 5,900 feet in the Madison lime.

Further acidization is to be given to this producer as soon as weather conditions lift road bans to the area. Another of the company's wells is Union National Del Bonita No. 1, also in the Madison at 5,200 feet. Both wells are on the company's acreage and are 17 miles apart on the same trend. Gravity of the oil is 38° to 40° with a combined gas and water drive. Two others are drilling with still another projected. Present development of this area is of general interest.

G. Maxwell Bell and Associates of Calgary have been responsible for the incorporation of a number of oil companies which have been active and successful. The companies are Calvan, Polaris, Zodiac, Garrison and Garnet.

They have been operated generally in association with Pacific Petroleums Limited, in that the same properties have been purchased with varying interests for each. Most of these interests are in the Redwater field. In the government sale of Crown leases in Redwater held on May 11, purchases were made which enhanced the values of all these companies. Early in June a farm-out of 80 acres was secured by the group from National Petroleums close to its discovery well in Spring Coulee in the south. A test well is to be drilled when a road is completed to the site.

Husky Oil and Refining Limited, of which Glenn E. Neilson is president and director, is a subsidiary of Husky Refining Company of Wyoming. The company has an important holding of Crown permits, reservations and leases totalling about 4,850,000 acres in Saskatchewan and Alberta. A major refinery operates in Lloydminster to process the "black oil" of that extensive field.

By-products of the refinery include a valuable high-quality asphalt and also a fuel oil for which demand is increasing due to conversion by the railways from coal to oil burning locomotives. New uses for this oil are continually being developed which are expected to reach additional markets during the present year.

Clifton C. Cross and Company Limited is a well known firm in connection with Alberta's oil development over a number of years. The company was responsible for the incorporation of the Globe, Leduc West, East Leduc and British Empire companies, all of which have prospered. The first three were the first independent companies to get production at Leduc, and British Empire at Stettler extended the field there by some three miles to the north with its first two wells.

Clifton C. Cross

Redwater Leaseholds Limited has attracted notice for its development of the Campbell area 12 miles to the northwest of Edmonton. Four wells are producing there from the Lower Cretaceous, the fourth having struck a productive zone at 3,758 feet, which gave an open flow potential of 1,200 barrels of oil a day. Many additional sites adjoining are to be tested by this company. R. P. Leveque is president of Redwater Leaseholds.

Canadian Gulf Oil Company has met with success in Alberta oil operations by the discovery of wet gas at Pincher Creek and the Stettler crude oil field. The former awaits decision on the question of gas export being permitted, and the latter is being developed into a major oil field. Gulf now has seven producers at Stettler and about 40 at Redwater. Geophysical exploration is being carried out, and seven seismic parties are in Alberta. Controlled reservations total 3,198,673 acres. A total of 66 wells have been either drilled or are drilling. J. H. Bevel of Calgary, general agent, heads the company.

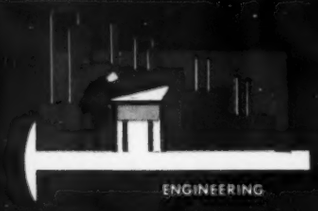
C. R. Spencer

Superior Oils Limited, of which C. R. Spencer is president, was founded in 1945. It has many interests which include a two-thirds interest in 16 Lloydminster producers, 17.5 percent in four wells at St. Joseph Lake, 25 percent interest in two wells at Leduc and 12.5 percent in eight wells at Redwater. Added to these are varying properties, or interests in properties throughout the province.

Mr. Spencer is president also of General Petroleums Limited, incorporated in 1941, which operates a contract drilling business. This has been extended to include participation in producing wells and exploratory acreage in Alberta and Saskatchewan. Eleven rigs are operated, and there is participation in 17 producers in Lloydminster, seven in higher grade crude wells in different parts of Alberta, and two gas wells.

Northwestern Utilities Limited and Cana-

(Please turn to page 75)



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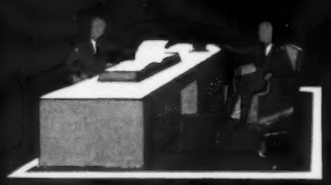

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International news and notes

Italian Engineers Visit U. S.

Recent visitors to the United States included a party of technical experts from Italy consisting of Dr. P. Varoni Borranci, Dr. Cesare Gavotti di Castellaro and Prof. Georgio Roberti, who are associated with the well-known Italian company, Azienda Generali Italiana Petroli. The particular purpose of their trip was to study the natural gas industry of the United States in view of the important gas discoveries made by AGIP in the Po Valley. In their inspection of fields, plants and laboratories in the midcontinent and Texas, they were accompanied by W. E. Lemen of the engineering firm of J. F. Pritchard & Co., and K. H. Weil, vice president of North American Utility and Construction Co.

A. C. Jennings

New Commonwealth Manager

A. C. Jennings has been appointed general manager of Commonwealth Oil Refineries, Ltd., Melbourne, Australia. He has been with the company since 1932 and prior to that was engaged in the motor industry. He served in both world wars as an artillery officer and prior to being commissioned was awarded the Military Medal. At present Mr. Jennings is on a trip to the United Kingdom and Persia. He will visit the Anglo-Iranian refinery at Abadan on the return journey.

Air Survey of Peace River Area

One of the most extensive airborne surveys ever undertaken in connection with the search for oil was put under way at the end of May in the Peace River section of northwestern Canada. The survey is being made by Canadian Aero Service Ltd. of Ottawa and is a cooperative undertaking of Socony-Vacuum Exploration Co., Stanolind Oil and Gas Co., Imperial Oil Ltd. and Canadian Gulf Oil Co.

An aerial magnetometric survey of this region is considered especially desirable because much of the area is heavily forested or muskeg country in which ground exploration would be extremely slow and costly. From the survey the oil companies hope to learn something of the basement depths, basement structures and other aspects of the rocks underlying the sediments.

According to Thomas M. O'Malley, president of Canadian Aero Service Ltd., one or two Anson twin-engine planes will be used in the survey. The planes have been outfitted as complex flying laboratories. Their equipment includes a precise aerial mapping camera, the Sonne continuous strip camera which records the path of the plane during the magnetometer survey and several electronic recording devices. The new high sensitivity Gulf airborne magnetometer will be used for the survey.

The survey will be flown at an altitude of 1,000 feet in a series of parallel lines spaced at 1½-mile intervals, with many intersecting control lines to correct for the severe daily variations of the magnetic field found in this part of the world. Over 16 million acres will be mapped. Flying will be completed in the early fall, and the data reduction and map compilation will be a continuing operation. The magnetic maps will be compiled on a scale of one mile to the inch, with a 5-gamma contour interval. The magnetic record will be precise to two gamma, a quantity of only one twenty-five-thousandth as great as the earth's magnetic field being measured.

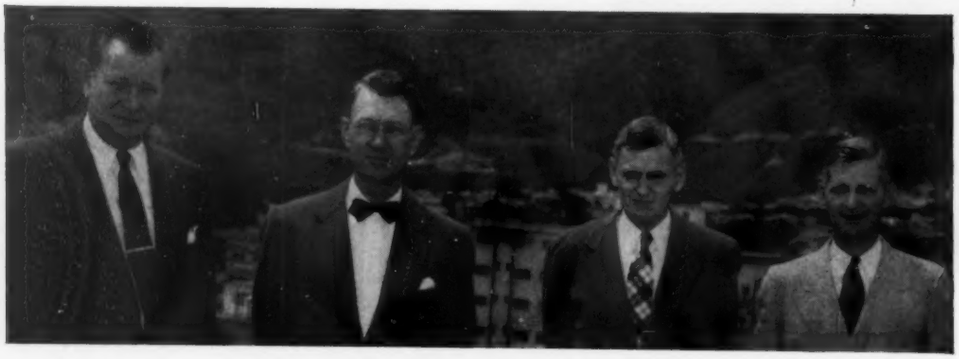
Project engineer for the survey will be Jack C. Webster, Canadian Aero Service Ltd. will draw on its affiliate companies, Aero Service Corp. of Philadelphia for some technical assistance, and on Spartan Air Services Ltd. of Ottawa, who will provide the plane and flight personnel for the survey. The pilots are former RCAF men with extensive aerial mapping experience over the bush country.

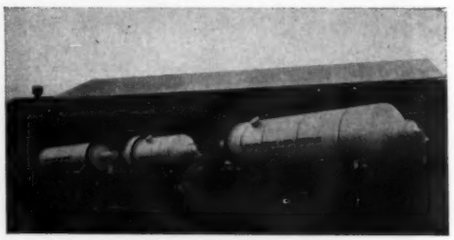
Exploration Parties in Venezuela

Exploration activity in Venezuela is now being conducted by 40 parties compared with 60 parties last year. The Seismograph figure for Shell includes one party which differs from conventional seismograph in that what are recorded are natural, and not man-made, earth currents. This party, contracted from Schlumberger, is the first of its kind in Venezuela. The District of Mara, west of Lake Maracaibo, where prolific Cretaceous limestone production has been found in recent years, continues to be the scene of greatest exploration activity, with 14 of the total 40 parties working in that area.

	Surface		Structure		
	Seis.	Geol.	Grav.	Drill	Total
Shell	5	4	2	—	12
Creole	1	5	2	—	8
Richmond	1	4	—	—	5
Socony	3	2	—	—	5
Mene Grande	1	1	—	1	3
Van. Atlantic	—	1	—	1	2
Phillips	—	2	—	—	2
Texas-Mercedes	1	1	—	—	2
Sinclair	1	—	—	—	1
	13	21	4	2	40

Ralph O. Rhoades, staff geologist for the Gulf companies, and Hollis D. Hedberg, head of exploration, New York Production Division, Gulf Oil Co., visited the oilfields of Venezuela during early April. This view, taken on the roof of Mene Grande Oil Company's building in Caracas, shows, left to right: George L. Lockett, chief geologist of Mene Grande Oil Co.; Mr. Rhoades; Mr. Hedberg; and Harold J. Funkhouser, assistant chief geologist for Mene Grande.





Vessels Enroute to Scotland

Ships Large Vessels to Scotland

Three large stainless steel vessels recently were shipped by Chicago Bridge & Iron Co. to the refinery being built at Grangemouth by Scottish Oils Ltd. The two larger structures are reactors, 9¼ feet in diameter by 38 feet, and the smaller structure is an 8½-foot-diameter by 22-foot catchpot. All three of these vessels are built of type 316 stainless steel.

J. Skliros Honored

J. Skliros has been invested by the French Ambassador in London with the insignia of Commander of the Legion of Honour in recognition of his services as managing director of the Iraq Petroleum Co., an office from which he retired on Dec. 31, 1949. Mr. Skliros was guest of honor at a luncheon given in Paris by the Compagnie Française des Pétroles to celebrate his promotion in the French National Order, to which he was admitted in 1935. The luncheon was presided over by E. F. H. Mercier, former president of Compagnie Française des Pétroles.

Petro-Tech Adds to Venezuelan Service

Petro-Tech Service Co., Lane-Wells affiliate in Venezuela, brought its total of service-and-sales stations to seven last year by establishing new installations in Anaco, Jusepin, El Tigre and Las Morochas. In January last year, Petro-Tech acquired the assets and business of Venezuelan Oilfield Service, operating in Eastern Venezuela, and on December 31 took over the well-logging and jet-perforating licenses and business of Seisdel. The parent company, Lane-Wells, in a report to stockholders, attributed the slightly lower rate of earnings last year principally to "the greater expense of doing business in Venezuela."

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Scottish Oils Celebrates Centenary

One hundred years of operation in the production of petroleum is the unique distinction of Scottish Oils Ltd., which is celebrating its centenary this year. According to the history of the time, it was in 1847 that seepages from shales attracted the attention of James Young, a young chemist, and led him to experiments as a result of which he received a patent for the distillation of paraffin oil from coal. At the Great Exhibition in London in 1851, a special medal was awarded to Young for his discovery.

The first plant operated by Young and his associates was built at Bathgate in Midlothian in 1850. The material first employed was Boghead cannel coal, and this coal was exported to America in the 'fifties for the production of burning oil under Young's patents. By 1862 the supply of coal from this source was exhausted, and Young turned to the retorting of shale with a recovery of 40 to 45 gallons per ton treated, as against 120 gallons obtained from coal.

At that time burning oil commanded a price of 60 to 80 cents per gallon, which enabled good profits to be obtained, but when Young's patents ran out, the price dropped to 35 cents. Owing to improvements in retorting, however, an increased recovery of nitrogen from the shale made it possible to obtain a greater amount of ammonium sulfate and to continue operation.

The production of ammonium sulfate served a dual purpose, as it made use of the ammonia produced in the retorting process and also covered the disposal of the waste sulfuric acid used in the refining processes.

Mining and retorting of shale, together with refining of the products, gradually increased to a maximum of 3.25 million tons in 1913. Operations in 1909 gave the following quantities of products:

Motor spirit	600,000	Gallons
Naphtha	4,400,000	"
Burning oil	20,000,000	"
Gas and fuel oil	12,000,000	"
Lubricating oil	10,000,000	"
Paraffin wax	25,000	Tons
Ammonium sulfate	54,000	"

Total value of the above products was two million pounds sterling, of which the value of the ammonium sulfate was £688,500, so it will be seen that the production of this chemical played a very important role in the economy of the Scottish shale oil industry. When the price fell owing to increasing production from other sources, it was a serious setback to the industry.

Many present-day processes had their birth in this industry; among them may be mentioned the continuous system of distillation, the chemical treatment of the various distillates, modern methods of sweating paraffin wax. In addition Young took out the first patent for the cracking of paraffin wax.

In the earlier days of the industry the retorted shale was classed as a useless byproduct, and large piles accumulated in the countryside adjacent to the retorting plants, but in recent years a method has been developed for making very good quality bricks from this material, known as SOL bricks. In the peak time of the industry about 15 retorting plants and eight refining plants were in operation, the industry at that time being very suitable for small and individual enterprise. That in fact was its solid foundation. In 1919 the six companies still in operation were amalgamated into Scottish Oils Ltd., whose ordinary capital in turn was subscribed by the Anglo-Persian Oil Co., now the Anglo-Iranian Oil Co. Ltd.

Owing to the economic difficulties of the subsequent period and increased competition, there have been successive reductions in the scale of operations until at present the output of shale is a little short of 1.5 million tons a year. This output is drawn from 12 shale mines, retorted in four crude oil works, and the crude products refined in a central refinery at Pumpherston. In addition there are two sulphuric acid works and a candle factory.

In recent years great improvements have been made in plant for handling oil shale and its products. The mining and transport of shale to the retorting plants has been highly mechanized, mainly electrically; and the mines are now lighted by electricity.

The Westwood retort erected in 1941 marks the highest development attained in such a plant. This retort has a capacity three times greater than the older retorts and its thermally self-supporting. Other features are mechanical handling of raw and spent shale, improved shale extraction gear, water quenching of the spent shale, which produces a portion of the steam required in the operation, water-cooled condensers and the installation of waste heat boilers.

The ammonia recovered in the retorting process is converted into ammonium sulfate at the retorting plant. The refining of the liquid products from all the retorting plants is concentrated into one plant at the Pumpherston refinery, which has been equipped with modern refining equipment, attention being concentrated on the manufacture of motor spirit, solvent naphthas, diesel oil and paraffin wax, while recently the manufacture of a new detergent. "Iranopol," from one of the shale oil fractions has been commenced.

After 100 years the Scottish shale oil industry is still very much alive and shows promise of continued virility.

Shale Oil in Brazil

A company formed in Sao Paulo with a capital of $800,000 U.S. has begun extracting oil from bituminous shales at Pindamonhangaba, about 100 miles from the capital. The first retort has been brought into service, and three others will begin operating within the next few months. The company aims at extracting 100 tons daily in the near future.

In accordance with the Four-Year Agrarian Plan, inaugurated in 1947, the Department of Mineral Production has been investigating the economic possibilities of utilizing Brazil's impregnated shales and schists. Deposits have been discovered in ten states, the most important occurring in the Tremembè-Taubatè district of the Paraiba Valley in Sao Paulo. A small part of these deposits is being exploited by the Companhia Nacional de Oleos Minerais, which has ordered a modern plant from the Foster Wheeler Corp. to produce 3,300 gallons of fuel oil daily. The cost of production with the new plant is estimated at $2U.S. per barrel of 159 litres, approximately the same as that of oil from the Bahia wells. The beds worked by the company are said to be capable of yielding 20,000 barrels daily during many years. Samples analyzed in the Laramie laboratory of the U.S. Bureau of Mines yielded 36½ gallons of petroleum per ton, or 6½ more than the Colorado schists.

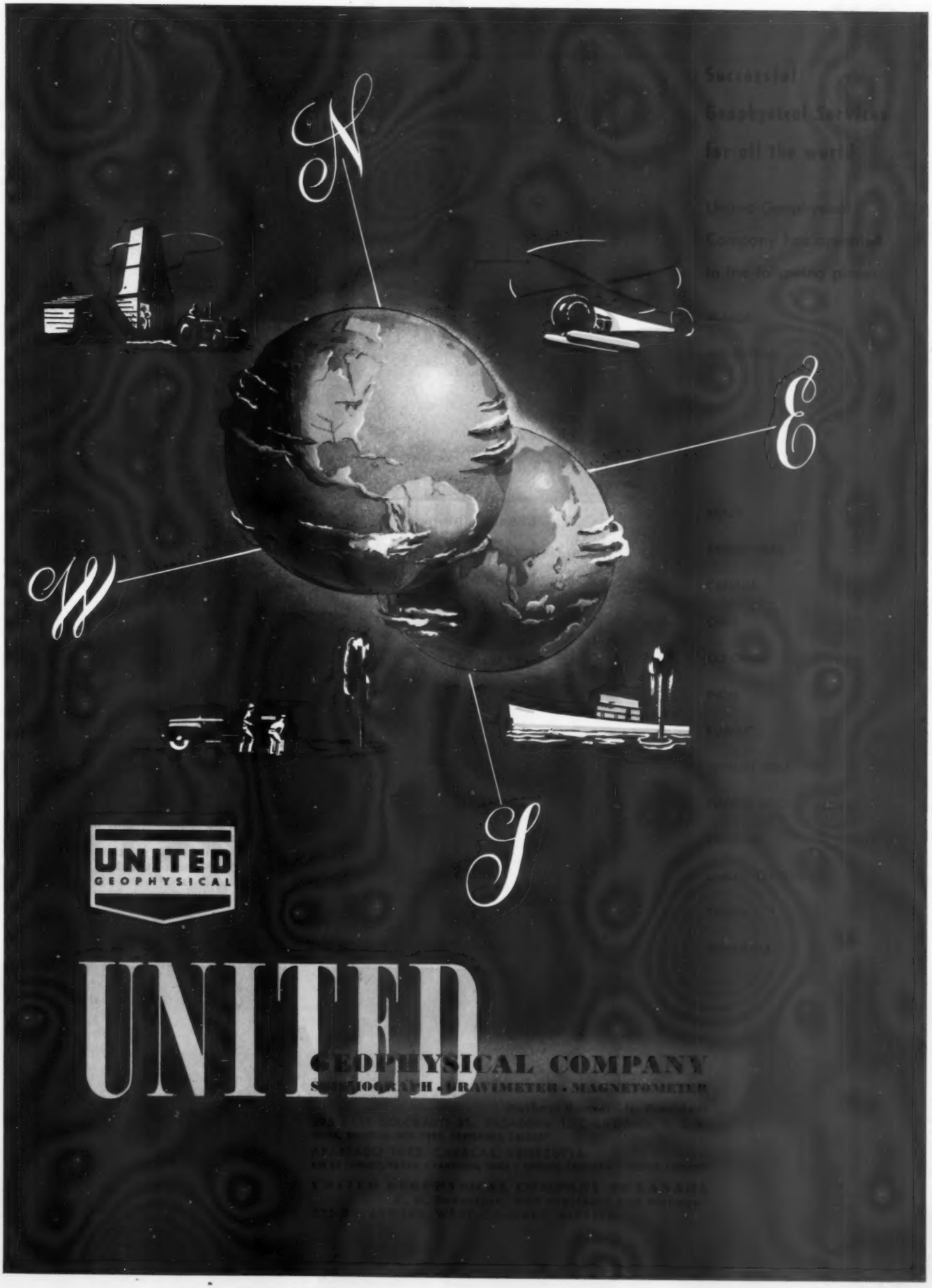
Other important shale beds occur in Ceara, where a Brazilian firm was authorized to prospect in October last, at Marau in Bahia, and in Alagoas, Amazonas, Paraná and Sao Paulo. The geological formation known as the black Irati schists extends for hundreds of miles, with small gaps, from Goiás through Sao Paulo, Paraná, Santa Catarina and Rio Grande do Sul. The layers vary in thickness from 100 to 200 feet, and favorable conditions for commercial exploitation exist at many points.

Referring to the movement to develop shale oil in Brazil, Dr. Silvio Froes Abreu, director of the National Institute of Technology, stated recently that, in principle, distillation from impregnated shales can be justified. Its advocates seek a certain source of oil instead of an uncertain one. It is not clear, however, that it can be organized on an economic basis in Brazil. If the present situation as regards petroleum is maintained, he added, the problem of shale oil must be examined as a possible source of liquid fuel supplies.

To Open Office in Rome

Aramco Overseas Co., a subsidiary of the Arabian American Oil Co., is planning to establish an office in Rome, Italy. This new office will be used primarily as the European engineering headquarters and for recruiting Italians for employment in Saudi Arabia and for the purchasing of equipment, materials and supplies for soft currencies. Rome has long been a stopover for Aramco's two DC-4 plants on regularly scheduled trips between New York and Dhahran, Saudi Arabia. R. S. Fowler, vice president of Aramco Overseas, will be in charge of the Rome office.

Foreign visitors in attendance at the Los Angeles Chapter Nomads April meeting, front row, left to right: E. N. Mitchell, Philippine Oil Dev. Co.; E. W. Hannay, Arabian American Oil Co.; R. H. Deem, Shell of Colombia; V. E. Freel, Drilling & Exploration Co., Brazil; back row, left to right: F. Vermersch, S.C.P., French Moroçco; Gerard Landroit, S. N. Repal, Algeria; H. G. Karnes, Iraq Petroleum; B. L. Coker, I. P. C. Syria.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Oil company staff changes

Edmonton Refinery Appointments

M. T. Stevens has been appointed construction manager of the new refinery to be built by British American Oil Co. at Edmonton, Alberta. N. J. Wills has been made construction superintendent. Mr. Stevens is manager of the company's Calgary refinery and will continue to supervise operations there in addition to his new duties. Mr. Wills is being transferred to Edmonton from Montreal where he has supervised the large expansion program which doubled the East Montreal capacity.

H. F. SINCLAIR was made honorary chairman at the recent organization meeting of the board of directors of Sinclair Oil Corp. The election was a tribute to his achievements in building up the company which he founded in 1916. The action was taken following Mr. Sinclair's announcement that he wished to retire and did not desire to be reelected as chairman. Mr. Sinclair will continue to serve as a director and also will be available as a consultant with respect to the company's business and affairs.

P. W. Thirtle, comptroller of the company, was elected vice president, and H. Jeffries, formerly assistant comptroller, was elected comptroller. S. H. McManus was elected assistant comptroller. E. L. Wagon, formerly assistant comptroller, was appointed special assistant to Mr. Thirtle. All other officers were reelected.

R. T. COLQUETTE has been elected vice president in charge of manufacturing of Pan-Am Southern Corp., New Orleans. Dr. J. W. Bertetti was appointed manager of the El Dorado, Ark., refinery; H. K. Wheeler, technical director; J. D. Walk, assistant technical director; and R. R. Gumaer as technical assistant to Mr. Colquette. Mr. Colquette and Mr. Gumaer will move from El Dorado to New Orleans.

K. H. CRANDALL has been elected a vice president of Standard Oil Co. of California. Mr. Crandall is a director of Standard Oil Co. of Texas and vice chairman of The California Co., a California Standard producing and marketing subsidiary operating in the Rocky Mountains and the central and Gulf Coast regions. He joined The California Co. in 1925 as an assistant geologist and subsequently was placed in charge of all geophysical work for that company and Standard of Texas. He became a director and vice president of The California Co. in 1942 and president in 1945.

ROBERT G. MILLS, former party chief for United Geophysical Co. in Canada, has accepted a position as seismologist with British-American Oil Co. in Canada.

G. Harold Osborne

G. HAROLD OSBORNE has been appointed general manager of sales for the Kendall Refining Co., Bradford, Pa. Mr. Osborne started with Kendall in 1933 as a refinery employee in the canning and shipping department. Successively he worked in the laboratory and sales department, in 1944 being made marketing assistant to the late Russell A. Keck, his predecessor as general manager of sales.

D. W. McGIBBON was appointed treasurer of Imperial Oil Ltd. at a meeting of the directors following the recent annual meeting. He was formerly assistant to the treasurer and in this position succeeds the late Kenneth A. Henderson, who was also a vice president. Mr. McGibbon joined Imperial at Sarnia refinery in 1932, and after training courses there and experience in the manufacturing department in Toronto, he returned to the refinery as budget controller. In 1940 he was transferred to the comptroller's office in Toronto to direct financial analysis and to handle special assignments. In the spring of 1948 he attended the advanced management course at Harvard Business School and shortly afterwards became assistant to the treasurer.

Heads Shell Chemical Activities

W. F. Mitchell has been appointed general manager of Shell companies' chemical activities outside of Canada and the United States with headquarters in London. Mr. Mitchell spent many years in the Shell operations in Canada as manager of the technical products department, operations manager and sales manager. He was transferred to London in 1947 to take up a senior position with Shell Petroleum Co. in the industrial development department.

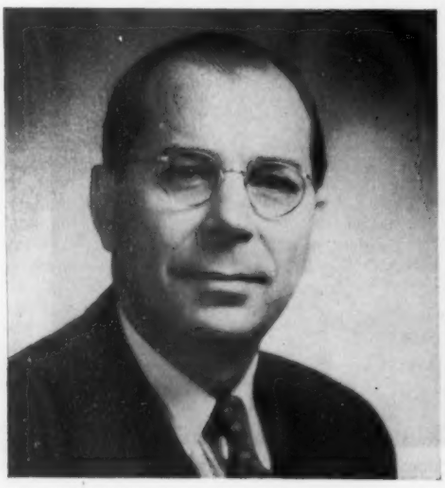
WESLEY G. GISH, vice president of the land and exploration division of Deep Rock Oil Corp., is leaving the company to enter the private practice of petroleum geology.

M. W. KIBRE has been appointed manager of the gas department, General Petroleum Corp., Los Angeles. He succeeds H. L. Eggleston, resigned. Mr. Kibre joined General Petroleum in 1929 in the company's Santa Fe Springs laboratories. He became a chemist in the gas department in 1933, an engineer in 1938 and superintendent in 1943.

R. G. BECHTEL, T. L. REGAN and **K. W. BOLT,** division production superintendents for Stanolind Oil and Gas Co., have been transferred to new posts. Mr. Bechtel, formerly division production superintendent in Stanolind's Texas-Louisiana Gulf Coast division at Houston, has been transferred to the Rocky Mountain division, Casper, Wyoming. He is succeeded by Mr. Regan, who has been division production superintendent for the central division in Oklahoma City. Mr. Bolt will move from the Casper to the Oklahoma City post.

M. L. HAIDER, general manager of production and a director of Imperial Oil Ltd., was also appointed a vice president following the recent annual meeting. After experience as an analytical chemist, Mr. Haider began his career in the oil industry as a research engineer in the field of natural gas. In 1938, after a varied experience in exploration and production, he became head of the production research and engineering department of the Standard Oil Development Co. He remained in this position until 1945, when he joined the Standard Oil Co. (N.J.) producing department. He came to Imperial the following year as head of its producing department.

K. H. Crandall



D. W. McGibbon

M. L. Haider

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Heads Fawley Training Program

Dr. F. Mayo has been appointed acting assistant refinery superintendent of the new Fawley refinery of Anglo-American Oil Co. He will be in charge of training technical and supervisory employees who will operate the plant with the assistance of R. H. Angibault. Dr. Mayo was formerly process superintendent and served in a number of capacities at Fawley for 15 years. He was appointed manager of the technical service department in 1945.

Dr. A. W. Pierce will become acting process superintendent.

Court Upholds Government on Tidelands

In a decision handed down on June 5, the Supreme Court of the United States upheld the claim of the federal government to control of tidal waters off the coasts of Texas and Louisiana and of mineral wealth including oil that may be found beneath such waters.

In the suit against the State of Texas, the court divided four to three, with two members abstaining, but in the case of Louisiana the same seven members were unanimous. The decision follows one rendered in 1947 against the State of California in a similar action. The judges agreed that the same conditions existing on the Pacific Coast in which it had decided that the national government had "full domination and power" over tidelands applied equally to the waters of the Gulf.

According to the court's order, final decree is to be entered on Sept. 15 when state and federal officials were directed to have an agreement prepared to put its decision into effect.

Under the terms laid down, there is nothing to prevent the leasing of tidelands to private operators, but control of such areas will be under the Department of the Interior. Meanwhile, a bill to quitclaim such coastal areas to the states is before Congress, but even if it should be passed, it presumably would be vetoed by the President, as happened in the case of a previous measure.

Left to right, William E. Stevenson, Ralph L. Boyer

New Cooper-Bessemer Directors

Ralph L. Boyer and William E. Stevenson have been elected directors of Cooper-Bessemer Corp. Mr. Boyer is vice president and chief engineer of Cooper-Bessemer. Mr. Stevenson is president of Oberlin College, Oberlin, Ohio.

Mr. Boyer has recently pioneered such notable developments as the gas-diesel engine, the Turboflow and the supercharging of four-cycle spark-ignited gas engines. He started his design career with Cooper-Bessemer in 1926 as diesel engineer, later to become assistant chief engineer, then chief engineer until his election to vice president and chief engineer in 1947.

The selection of Mr. Stevenson by Cooper-Bessemer shareholders was based on the valuable counsel that his background and experience can give to the firm on varoius aspects of its business, particularly in the field of public relations.

Paper on Catalysis

Dr. O. Beeck, associate director of research at the Emeryville, Calif., laboratories of Shell Development Co., read a paper on "Heterogeneous Catalysis" at the April meeting of the Faraday Society at Liverpool. While in Europe, Dr. Beeck is visiting Shell laboratories in England and Holland. Dr. Beeck has published about 40 papers on catalysis, lubrication, chemical physics and fundamental phenomena in gas discharges. In particular he is a notable authority on catalysis, the subject dealt with in his paper to the Faraday Society, and is a past chairman of Gordon Conferences on Catalysis as well as a member of the Committee on Catalysis, National Research Council.

Semi-Portable Compressors

Ingersoll-Rand has introduced a new line of gas-engine-driven compressors, available in three sizes, 110, 165 and 220 horsepower. These machines consist of four, six and eight power cylinders respectively. They are a "packaged" version of the angle-type compressors, light enough to meet all requirements for semi-portable use in the field, yet built to standards usually demanded in a permanent installation.

East Approaches Oil Balance

The Eastern Hemisphere is in sight of self sufficiency in oil supplies, Howard W. Page, Anglo-American director, told the Institute of Petroleum, London Branch recently. He said that it seems reasonable to anticipate a new volume of movement of petroleum from the Eastern Hemisphere to the West in about two years. When Eastern Hemisphere refineries, now building, come into full operation, residual fuel oil will be pushing for new outlets and perhaps invading the west.

Good Gas Service makes —

Natural Gas IN ALBERTA

Dependable, Efficient and Low in Cost

Demand for Natural Gas in Alberta has increased from 12,000,000 M.C.F. in 1939 to over 35,000,000 M.C.F. in 1949. It is used by one household of every three, and by practically every industry. 8,500 more consumers will be added in 1950. This steadily climbing demand is due not only to the abundance of Natural Gas in Alberta, but because these business-managed gas utilities maintain their plants at a high standard of efficiency and their services ever ahead of consumer requirements. They thereby make Natural Gas both dependable and efficient, and by distributing it at one of the lowest rates on the Continent, also economical.

Alberta Is Canada's Natural Gas Province

This year, these two business-managed natural gas utilities will spend over $6,000,000 in replacements, improvements and extensions.

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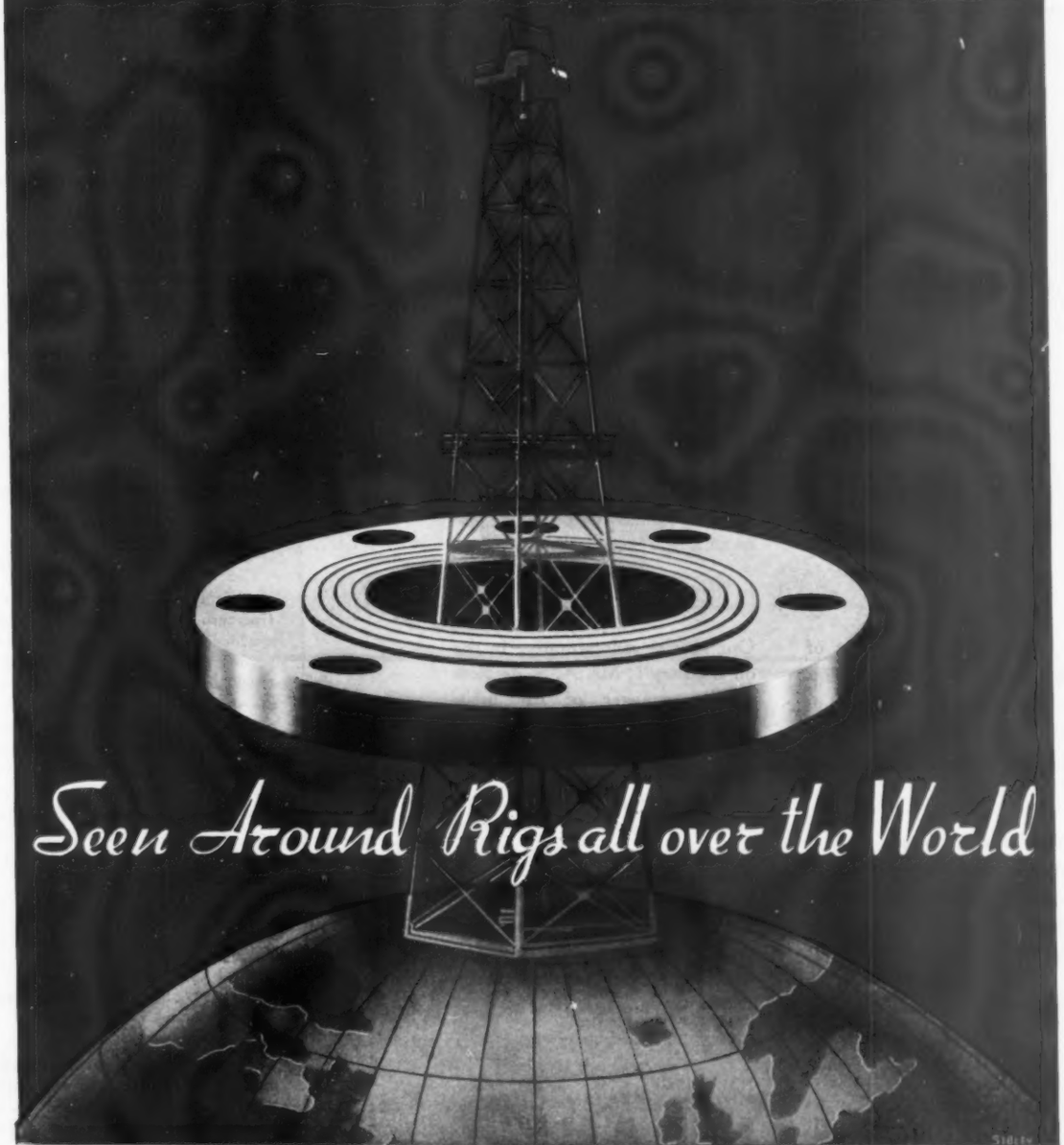

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New Welding Electrodes

The Quasi-Arc Co. Ltd., Bilston, England, has recently introduced two new electrodes of particular interest to the oil industry. Both cover special applications of welding technique. The Quasi-Arc pipe welding electrode is designed for the welding, in situ, of pipe without the use of backing rings and with readily controlled penetration. This latter feature is especially important as, on pipe welding without backing rings, the permissible limits of penetration are very narrow.

Another new electrode is the Quasi-Arc pressure vessel electrode for the welding of high quality fabrications and pressure vessels, particularly those subject to radiographic examination to Lloyds Class I or Admiralty Grade A standards. This is an easily controlled electrode depositing an extremely solid weld metal with a neat finish and having a slag which is readily detached from the weld. The weld metal deposited in prepared butt joints has a concave profile which assists slag removal, while good penetration ensures soundness between runs. This electrode is designed for use in the downhand position and has a specially selected high quality mild steel core wire.

Plan School "Pilot" Program

A "pilot" school relations program will be tested by the Oil Industry Information Committee next fall. Objective is to help teachers and students alike to reach a better understanding of the operations and achievements of the petroleum industry. To accomplish this, booklets, charts and other literature will be prepared to complement classroom studies. For the 1950-51 school term the program will be limited to junior and senior high schools in two counties in each of the Oil Industry Information Committee districts.

New Book

Oil in the Modern World, by Raj Narain Gupta, published 1950 by Kitab-Mahal, Allahabad, India; 170 pages, 8Rs or $2.

This small book on the general situation of oil production and distribution in the world is of interest mainly because of the picture it gives of the pulling and hauling of foreign companies and governments over the rich fields of the Middle East and southeastern Asia, while the native governments are impotent to develop for themselves their own natural resources. The Anglo-American Oil agreement is criticized from this viewpoint. Some suggestions are made for the creation of an international oil body that would work out a fair and equitable distribution of the world's oil.

Abandons Ethiopian Test

Sinclair Petroleum Co. has abandoned its well No. 1 Gumburo in the Ogaden area of Ethiopia. It was spudded in on May 17, 1949, and drilling was suspended April 7, 1950, after reaching a depth of over 10,000 feet. Since it was an initial exploratory test, the well was very carefully cored and tested, and important geological data as to formation and stratigraphy were obtained, which have caused the company to proceed with an extensive geophysical program. The geophysical operations will be augmented by surface geological studies and a magnetometer survey. The location for a second well is being postponed until geophysical and geological studies have been further advanced.

New Book

Natural Gas Economics, by Joseph A. Kornfeld; published 1949 by The Transportation Press, Dallas, Texas, 261 pages, $5.00.

The declared object of this book is to present the major economic problems confronting the natural gas industry of the United States. To that end the author has collected and integrated a compilation of facts taken from the scattered literature of the subject. He first considers the place of natural gas among available energy sources and the trends in the natural gas industry. Then he compares gas conservation from the viewpoints of a gas pipeline operator, an oil company and a state regulatory body. From there he passes to synthetic fuels, finance, storage, reserves, production, price, transportation and regulation (including recent conservation orders and their implications). The fly-wheel of the natural gas industry is, naturally, the demand for this commodity. His analysis of this phase of the subject is informative.

CARLOS C. BLOUNT, former assistant chief engineer has been appointed refinery safety engineer at Deep Rock Oil Corporation's Cushing, Okla. refinery. He is succeeded by Robert A. Forsman. Jon W. Beam, former supervisor of instruments, has been named development and instrument engineer, a new position.

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Our special representative in the oil industry is Mr. A. S. de Rosenroll, manager of the main branch of the Imperial Bank in Calgary. His knowledge and experience are available to you as part of the Imperial Bank's facilities in the west. We maintain three branches in Calgary, five in Edmonton, and over fifty branches in the provinces of Alberta and Saskatchewan. Our Branch Managers are eager to serve your new industry's needs in every way.

IMPERIAL BANK OF CANADA

IMPERIAL BANK 75th ANNIVERSARY

Oil Companies of Western Canada

(Continued from page 64)

dian Natural Gas Company Limited, of which F. A. Brownie is president, supply Alberta with natural gas, the former covering Edmonton and a general area south to Red Deer, and the latter serving Calgary, Lethbridge and intermediate points in southern Alberta. Customers supplied by Canadian Western in 1949 numbered 40,202; estimated for 1950, 43,678; by Northwestern for 1949, 37,088; estimated for 1950, 41,600.

About $4 million is to be spent on expansion of Northwestern in the current year and $2 million on Canadian Western. This includes an eight-inch pipeline from the Leduc field to Edmonton for additional gas supply, pipeline extensions in the northern area, distribution lines, new intermediate pressure lines, the drilling of additional gas wells and other forms of expansion.

The main contractors for construction of the Edmonton to Regina section of the Interprovincial Pipe Line to Superior are the Canadian Bechtel Company, associated with the Fred Mannix Company of Calgary, Alberta.

It is a matter of particular interest to Albertans that the responsible task of building the home section of the great pipeline will be in the hands of this well-known Albertan company.

F. A. Brownie

An important factor in recording and encouraging Canadian oil development has been the Daily Oil Bulletin, directed by Carl O. Nickle of Calgary, its capable editor and publisher. Mr. Nickle is also associate editor with Leslie O. Rowland of "Oil in Canada," a magazine published by the Stovel Press Ltd. in Winnipeg.

The Nickle Map Service, S. C. Nickle, director, has for many years served the oil industry with maps covering many phases of development in the different fields, established and exploratory, throughout western Canada.

With the tremendous oil development in western Canada during the past three years, there has been naturally a continuous increase in the formation of new companies to take part in the great job that has to be done. It has been a job of exploration of new areas and proving up those which have become established. Also the many types of supply companies to keep this work going have continually increased.

Added to this there has been a large influx of old established oil companies from the United States, which naturally have wished to become a part of this great and active program. There are too many of these to enumerate in full. Among the more prominent are the Amerada, Rio Bravo, Stanolind, Socony-Vacuum, Barnsdall, Phillips, Texaco, Sunray, Tide Water, Standard of California, Union of California and Sohio. There is room for more. The objectives to be reached are big ones, for they deal with benefits to economy which are provincial, national and international in scope.

Ideco Moves Offices

Executive, machinery and export and supply stores headquarters of the International Derrick and Equipment Co. were moved May 29 from the Ideco Building to the new Atlantic Building in Dallas as part of the company's expansion program.

Federated Petroleums Ltd.

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Drilling in Venezuela

Mene Grande's Los Mangos 1 was a successful new-field completion of late May, while the same company's Leona LXM-201 discovered two new pools. Their Oficina OG-288 was a one-sand discovery. Creole's Alturitas 1, deepest hole outside the United States, was testing as June began and yielding large quantities of oil from two distinct sand groups in the Eocene.

A joint Shell-Atlantic wildcat, Guama 1, eight miles north of the Tucupido-Taman field, was spudded in late May, and Mene Grande began the drilling of new-field test Cerro Pelado 1, five miles west of La Ceiba and 20 miles from the Santa Ana field.

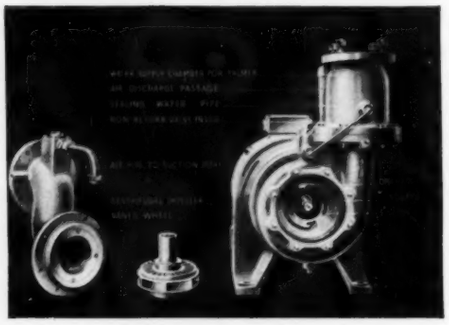
Production records were spectacularly broken after the labor strike of early May. Venezuelan daily production passed a million and a half barrels for the first time in the week ending May 29, 1,512,706 barrels per day. This high was broken immediately when 1,536,682 barrels per day were averaged in the week ending June 5. Nevertheless, it was estimated that May production would be some 200,000 barrels per day under April, when the monthly average was 1,441,243.

Principal factors contributing to the increase were twofold, depletion of stocks during the strike and increased demand arising from new European and Latin American contracts.

Repressuring at Eakring

The wartime British oil field at Eakring in Nottinghamshire is now being subjected to experimental treatment with a view to prolonging the life and output of the field. Repressurization is being carried out by pumping large quantities of water daily into the substrata. By this means it is hoped to recover some 60 percent of the oil resources instead of the 30 percent originally estimated.

This procedure is already showing results. Output as a whole is appreciably higher than it was two years ago, and some of the wells are giving double the former quantity of oil. When the field was first surveyed about 1939, it was given a probable life of from 10 to 15 years. As a result of the repressurization, it is anticipated that the field will have a life of some 30 years. Thirteen water injection wells have been drilled around the perimeter of the field, and a fourteenth is in process of beginning.



New Centrifugal Pump

Self-Priming Centrifugal Pumps

A new design of self-priming centrifugal pump, the "Cevac," is manufactured by Worthington-Simpson, Ltd., Newark-on-Trent, England. The "Cevac" pump embodies a combination of the vortex type air or vacuum pump with a perfectly normal impeller, simplified to the extent that the two impellers are cast in one piece and operate in the same chamber. It has no more working parts than an ordinary non-priming centrifugal pump.

The main pumping element is a single entrance centrifugal impeller of conventional design and high efficiency, and the priming element in no way interferes with the design or efficiency of the centrifugal impeller. During the priming operation, the vortex pump operates alone, extracting air from the suction pipe, rapidly and efficiently up to 24-inch vacuum and, if specially desired, up to 27-inch vacuum. After priming, the vortex pump handles the liquid being pumped and so operates as a liquid pump in parallel with the centrifugal.

The system is a closed one; air drawn from the suction line is discharged into the pressure line. This feature makes the pump ideally suited for handling volatile liquids, especially petrol, as there is no discharge of vapor or liquid to atmosphere and no atmospheric air can get into the system. Also, as the unit gives a centrifugal pump characteristic curve, there is no disadvantage in running on a closed discharge valve. The pump is not suitable for handling gritty or very dirty liquids on account of the close clearance required between the vortex pump wheel and the port plate. The port plate is renewable in the event of excessive wear due to grit.

Winslow Sales Manager Appointed

Appointment of W. Ray Kern as sales manager of Winslow Engineering Co., manufacturers of Winslow filters and elements, has been announced by Wm. G. Nostrand, vice president in charge of sales and engineering for the Oakland, Calif., firm. Mr. Kern resigned as vice president and general manager of Berglund Tractor and Equipment Co. to accept the new post.

Correction

In an article relating to Drum Compound Applying Equipment published in the June issue of this magazine, an inaccurate impression was conveyed by the statement that Dewey & Almy Ltd. had been licensed by Moon Bros. as worldwide selling agents of the equipment. The fact is, we are informed, that Moon Bros. are manufacturers of the equipment which was originated by Dewey & Almy Ltd., who are sole proprietors and sellers.

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U. K. Derationing Admits More American Oil

LONDON

THERE have been some noteworthy changes during the past sixty days affecting the position of the oil industry in Britain and particularly in the attitude of the government toward the use of petroleum products. The first of these was provided in the budget presented by Sir Stafford Cripps on the reassembling of Parliament in late April. Among its proposals the one that gave rise to the most immediate and most heated discussion was the doubling of the tax on petrol from ninepence (10.5 cents) per gallon to one shilling, sixpence (21 cents).

While the Laborites were able, by a very thin margin, to repel the Conservative attack on this measure, it was received with considerable dismay by the general public. It forced an immediate advance in the price of gasoline to three shillings, three farthings (43 cents) per gallon and brought strong protests from those interests whose businesses required its use in substantial quantities. As a concession to taxicab operators, they were permitted to add three pence to their fares, but this was received with a great deal of grumbling because it applied indiscriminately, regardless of the length of the trip, and brought an announcement that it was only a temporary device which would be revised later on a more equitable basis.

More serious to the mass of workers were reports that bus fares would shortly be increased, while the operators of vehicles engaged in highway transport had a double cause for complaint. Not only were their fuel costs increased, but the budget also placed a sales tax of 33⅓ percent on commercial vehicles. It was immediately charged that this was a scheme to divert traffic from the highways and to reduce the heavy deficit of the government-owned railways. The attempt to assuage disappointment over the heavy tax increase by permitting owners of private cars to operate them 180 miles per month instead of the 90-mile limit formerly applied was of little effect because it was regarded as entirely inadequate to meet the needs of business men and country dwellers.

Dissatisfaction with the new taxes and regulations was due not only to the increased costs imposed on a heavily burdened public but mainly because it confirmed the belief that the government intended to continue its policy of rigid restrictions on the use of a highly essential commodity and to do this through regulation by price, a policy which Labor party leaders had bitterly denounced when it was implied in proposals put forward by the Opposition.

After more than ten years of loyal submission to the most drastic deprivation of food, clothing, travel and other necessities and conveniences of life, the truth is that the British people have become restive under the continuation of these burdens, and this restiveness has been increased by the glimpses they occasionally get of the greater freedom enjoyed by their neighbors just across the Channel and by a growing belief that constructive policies would do more than unrelieved austerity to improve their lot as a nation and as individuals. This feeling manifested itself in the closeness of the February election and has been more in evidence since the debate on the budget.

This background is necessary for an understanding of the sudden action of the government in declaring an end of gasoline rationing. The move was timed to take effect just before the Whitsuntide holiday, when it would have the greatest popular effect. It followed a conference of government leaders at Dorking, where it presumably was decided upon. It is not unfair, therefore, to look upon it as a step designed primarily to improve the political atmosphere for the party in power. In explanation of the action, it was announced that it had been made possible by an agreement with two American-owned oil companies, Anglo-American of the Jersey Standard group and California Texas of the Texas-California Standard alliance, to supply the additional amount of oil consumed as a result of the removal of rationing. Payment for the oil is to be made in sterling, and the proceeds are to be spent in purchases of sterling products.

In press comments published in the United States, the deal has been hailed as marking a termination of the disagreement between the British and Americans over the exclusion of American-owned oil from sterling areas and the abandonment of the effort to substitute so-called sterling oil for that produced by American companies. Actually no such sweeping conclusion is justified. The official British position from the beginning has been that the only purpose of their substitution plan was to reduce their burden of dollar payments. American companies operating overseas have insisted on their ability to reduce the dollar costs of their oil to an equality with the dollar costs of British companies and their willingness to sell for sterling. Their demand was for an opportunity to compete on equal terms. Neither side, therefore, can be accused of abandoning its position. Increased consumption by the British market as a result of derationing is estimated at somewhere between four and five million tons, of which the Americans would be called upon to provide 1.5 to two million tons, divided between the two companies proportionately to their present shares in the market.

This is the extent of actual involvement in the new agreement which is made without prejudice to the negotiations which have been under way regarding the exclusion of American oil from sterling areas. It is reasonable to assume, however, that the arrangement covering the United Kingdom may make it easier to arrive at an amicable settlement in relation to other sterling areas. Australia had abandoned rationing before the London agreement, and it should not be difficult to reach an understanding along similar lines in other sterling territories.

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The tests which are being conducted daily in the field laboratories—for octane number determination, lead content, volatility, storage stability and the like—are generally standard inspection tests . . . but often go far beyond that in results. For example, a tetraethyl lead blending study recently conducted for one refinery demonstrated that a range of over $3000 a day in realization existed among the several schedules under consideration.

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In addition to handling any regular inspection or antiknock tests, the Du Pont field laboratories can be called on in an emergency to handle refinery control work, check your own laboratory results as well as to conduct special investigations.

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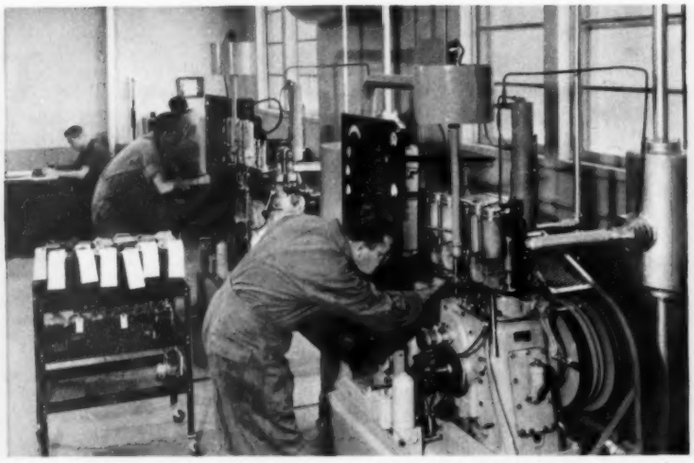
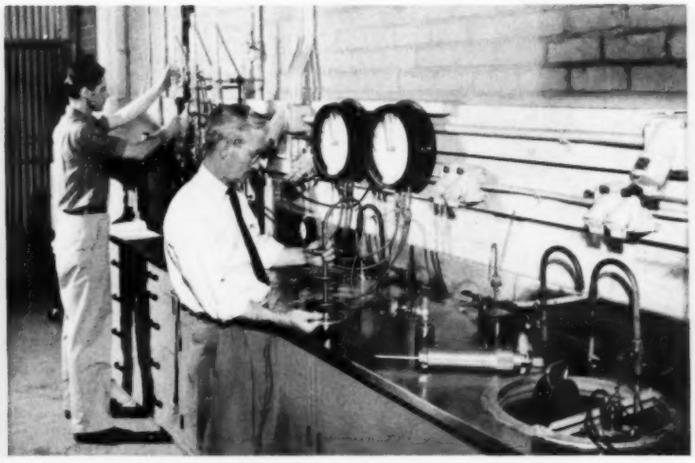
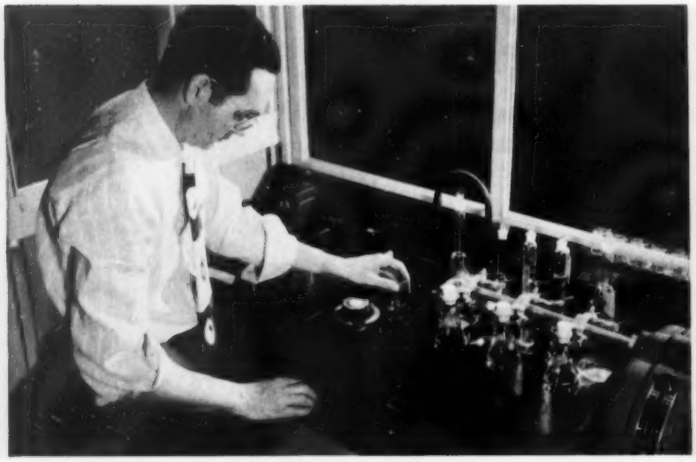


OCTANE RATING AND TEL REQUIREMENT TESTS—Of major help to you in evaluating your fuels and your TEL needs, as well as in checking your own laboratory findings, this service of the field laboratories is also utilized on a nation-wide basis to secure the comprehensive data for the Du Pont Quarterly Motor Gasoline Survey.



ANTIOXIDANT EVALUATION—Determination of a gasoline's antioxidant needs, in terms of the three Du Pont Gasoline Antioxidants Nos. 5, 6 and 22, is another service of the field laboratories. In a number of cases the recommendation of the laboratories has resulted in significant savings in antioxidant costs.



ECONOMICAL COPPER CONTROL—Du Pont field laboratories are equipped to analyze your gasoline for the presence of copper even when only traces are present, and make recommendations for its effective control with Du Pont Metal Deactivator. The use of this additive, as recommended by field laboratories, has helped a number of refiners materially to lower their antioxidant treating costs.

DYE RECOMMENDATIONS—Because Du Pont is the producer of a complete line of gasoline dyes, all field laboratories are prepared to help you select an identifying color for your gasoline. Newest of the Du Pont Gasoline Dyes is Du Pont Oil Blue A, a dye of high tinctorial strength, improved solubility, and meeting MIL-F-5572 Specifications for aviation gasolines intended for military use.

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A-591

Drilling Activities in British Columbia

First full-scale attempt to find oil in the Fraser Valley of British Columbia, some 30 miles from Vancouver, has been begun by two Alberta firms, Allenbee Petroleums and South Brazeau. The companies have obtained rights on nearly 40,000 acres in the neighborhood of Newton. First well will be known as Allenbee-South Brazeau No. 1. A drilling rig capable of reaching 4,500 feet is on the side.

New British Columbian oil exploration regulations passed at the last session of the legislature are now in effect. The new rules are amendments to the Petroleum and Natural Gas Act and bring the province's laws more in line with those in effect in Alberta. They provide for only one type of permit, a geological prospecting authorization which requires a geophysical license. Unit permit area is reduced from 15,000 to 10,000 acres with the period for renewal increased.

The new license provides for a minimum area of 320 acres and a maximum area of 11,520 acres. Annual rental has been cut from 50 cents an acre to 25 cents. If petroleum or natural gas is found, a lease must be obtained to cover from 160 to 5,760 acres. Not more than 50 percent of the lease can be taken from the operator. A crown reserve cannot be declared to cover any location in good standing. Not more than 50 percent of the area under license may be leased by any operator, and the remaining 50 percent reverts to the crown on a checkerboard pattern.

Austin C. Taylor, director of Home Oil Distributors and prominent Vancouver fiinancier, has applied at Victoria for three petroleum exploration permits of 100,000 acres each in the Peace River district.

Exploration parties are again active in the northland. A Shell seismograph party left for the area early in June, while others are already in the field.

Garson Mitchell, local operator who first staked land in the Monkman Pass area two years ago, says that operations in that district have been intensified and that survey parties are expected to cover 700 square miles there this summer. One well site has been chosen by Mr. Mitchell and his associates, and ten more will be located.

Pacific Petroleums are drilling in the Monkman region and are now down more than 7,600 feet. Drill stem tests have been made, but no announcement has been issued as to showings. Drilling of the Phillips Petroleum wildcat at Lone Mountain has now passed 7,300 feet.

Several thousand acres in the Caribo district have been filed on for exploration, and a well will be drilled by Kersley Gas and Oil Company on their holdings 15 miles south of Quesenel.

Stanolind Oil Co. has applied for another 148,000 acres of prospecting territory next to block it already holds in the Peace River district. Permits sought from the provincial government up until June 1 totalled 536,832. The province has already issued permits covering 9,700,473 acres.

Oil Progress Week Plans

The Oil Industry Information Committee has selected "Your Progress and Oil Progress Go Hand in Hand" as the central theme for the celebration of Oil Progress Week next October. The theme will be interwoven in all advertising copy, booklets, leaflets and other literature and materials prepared for the period of Oct. 15 through 21, when the oil industry makes it annual report to the public on oil's contribution toward better living for everyone.

Unit Project Report

Publication of a pamphlet "Unitized and Cooperative Projects in the United States" is announced by the Interstate Oil Compact Commission. Included is a bibliography and tables containing data on 29 cooperative projects and 128 unitized projects in 17 states. Four maps show the location of the projects in progress. Copies of the report may be obtained by writing the Interstate Oil Compact Commission, POB 3127, State Capitol, Oklahoma City 5, Okla.

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Canadian Refinery Capacity Up 50 Percent Since 1945

THE refining division of the petroleum industry in Canada has been expanding at a rapid rate since the close of the war. Even before the Leduc discovery and the subsequent Prairie province developments, refiners were building new units at existing plants to keep pace with the constant growth of demand for oil in the Dominion. In 1938, before the commencement of World War II, consumption of principal petroleum fields and lubricants in Canada was 42 million barrels, and in 1945 when the war was over, Canadian demand had risen 38 percent to 58 million barrels. Last year demand had increased 67 percent over 1945 to 97 million barrels, thus more than doubling the prewar consumption. Average rate of increase in the 11-year period from 1938 to 1949 was 10.8 percent per year.

Demand for gasoline has risen more rapidly than that for other products. In 1945 motor fuel consumption in the Dominion totalled 27 million barrels, while in 1949 it had risen 77 percent to 48 million barrels. In the same period automotive registrations had grown from 1,497,081 to 2,194,929. The increase in registrations was lower percentagewise than the increase in gasoline consumption. This may be accounted for partly by the fact that commercial vehicle registration rose 69 percent, while passenger cars on the road increased only 42 percent. Another element of some importance is the large motor fuel consumption of tourists from the United States. This was small in 1945, but touring has increased each year since the war closed.

There were 30 oil refineries in Canada in 1945 with an aggregate crude capacity of 231,215 barrels daily. Cracking capacity was 101,750 barrels. Net production of salable products that year was 59.9 million barrels. Since the close of the war crude capacity of operating plants has increased 50 percent to 348,850 barrels daily. Cracking capacity has risen 48 percent to 149,630 barrels daily. Net production of salable products in 1949 was 89 million barrels.

In the war period Canadian refineries had an impressive record of achievement in the production of synthetic rubber, aviation gasoline and other military fuels and lubricants. Aviation gasoline production, for example, was enlarged fivefold between 1940 and 1944 when it reached 3.5 million barrels.

The current construction of new refinery capacity in Canada is taking place both in the more populous provinces of Ontario and Quebec and also near the new oil fields in the Prairie provinces. A summary of crude capacities by provinces in 1945 as compared with midyear 1950 is given in the following tabulation:

Province	1950	1945
Nova Scotia	22,000	34,000
New Brunswick	300	250
Quebec	127,000	59,000
Ontario	86,500	75,450
Manitoba	5,800	4,500
Saskatchewan	37,100	18,075
Alberta	41,700	18,100
British Columbia	27,350	21,000
Northwest Territories	1,100	840
Totals	348,850	231,215

The importance of Montreal as a refining center was increased during the war by the construction of a pipeline from Portland, Maine, which was able to supply the plants with crude on a year-around basis. From a distributing standpoint, Montreal is an advantageous refinery location since it is in the center of a populous region and since water transportation is available for finished products over a wide area. Addition of a new 18-inch crude line this year will bring delivery capacity of the Portland-Montreal pipeline up to the current refining capacity.

Each of the Montreal refineries has been greatly enlarged since the close of the war. British American Oil Co. Ltd. is the latest to bring its new crude and cracking facilities on stream. Crude capacity of this plant is up from a recent 16,000 barrels to 32,000, and a fluid catalytic cracking unit has been added.

Shell Oil Co. Ltd. will not complete its refinery expansion program at Montreal until later this year. The construction now in progress will increase crude capacity from 15,000 to 25,000 barrels and provide a 10,000-barrel fluid catalytic cracker. Various auxiliaries to round out the plant also are being erected.

Imperial Oil Ltd. completed its $22 million modernization program at Montreal last year. Crude capacity has been increased to 37,000 barrels daily since the war and an 11,000-barrel catalytic cracker added.

McColl-Frontenac Oil Co. Ltd. has been engaged in enlarging and modernizing its Montreal works since 1946, and the job is now nearly done. The plant has been more than doubled. It now can process 40,000 barrels of crude daily. A catalytic cracker has been installed, thermal units revamped and much auxiliary equipment erected.

In Saskatchewan British American has increased the capacity of its Moose Jaw plant from 4,000 to 6,000 barrels daily. Two new plants have been erected at Lloydminster since the war. Husky Oil and Refining Co. has built a 7,500-barrel skimming and asphalt plant, and Excelsior Refineries Ltd. a 1,500-barrel refinery. At Saskatoon Hi-Way Refineries Ltd. has modernized and enlarged its plant, increasing the wartime size of 300 barrels daily to 2,800 barrels. Imperial has added 5,500 barrels of daily capacity to its Regina refinery, bringing the throughput to 16,000 barrels daily.

Capacity of Alberta plants as a whole has been doubled since the war, and further building is in progress. Prairie province plants soon will be able to take care of the product needs of their normal trade territory without imports from Rocky Mountain plants in the United States.

British-American has increased the capacity of its Calgary plant from 4,500 to 7,200 barrels since the war and now has begun construction of a new 6,000-barrel refinery at Edmonton. This plant will be equipped with a fluid catalytic cracking unit to give a maximum yield of high octane gasoline.

The capacity of the Imperial plant at Edmonton built since the war has been increased 60 percent to 16,200 barrels daily. McColl-Frontenac recently announced that it will build a $10 million refinery at Edmonton. This project will be completed in 1951.

Imperial has begun construction of a 10,000-barrel plant at Winnipeg to process nearby crude. This plant will be completed in May 1951.

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Sir Stafford Cripps Hits at Industry

The surprise of Britain's 1950-51 budget, announced in the House of Commons on April 18th by Sir Stafford Cripps, the Chancellor of the Exchequer, was the imposition of an increase of 9d per gallon on the customs duty on gasoline and other light oils and on heavy oils used as road fuel, together with the imposition of a 33⅓ percent purchase tax on commercial vehicles.

This increase of the customs duty on gasoline is equivalent to an increase of 8.5 cents per U. S. gallon and brings the cost delivered into the motorist's tank to 3s per Imperial gallon or 33.6 cents per U. S. gallon.

As a sop to private motorists these charges were accompanied by an increase of the basic gasoline ration, from an amount allowing a mileage of 90 per month per car, to one allowing 180 per month. The tax based on last year's consumption of motor fuels of all kinds, is estimated by the Chancellor to produce a revenue of about £73 million in a full year, but it is more than probable that this figure has been deliberately kept low in order to reduce criticism and that the true figure is nearer £90 million.

The Times says "The combination of higher petroleum duties and the new purchase tax on commercial vehicles is bound to increase industrial and commercial distribution costs, which is precisely the kind of effect which the budget under present conditions should seek to avoid; and it will increase the cost of road passenger transport. The Chancellor estimated that the increased petroleum duties alone would increase the cost of passenger transport (the 'overall cost,' not just the operating cost) by 4 percent in the country and by 5 percent in London. It is typical of the loose thinking the Government displays increasingly on this sort of subject that Sir Stafford Cripps remarked, without giving any reason at all, that this 'should not lead to many applications for increases in fares.' He spoke almost as if these new exactions, yielding about £85 million in a full year, could be absorbed without any ultimate effect on general costs and prices."

On April 4 the Parliamentary Secretary to the Ministry of Fuel and Power, in reply to a question said: "Doubling the present standard of 90 miles a month would cost approximately £12 million, since any additional consumption in the U. K. at the moment would have a 100 percent dollar cost."

The general assumption is that this tax has been put on particularly to assist the nationalized railways of the country, which have been running at a loss ever since they were taken over; and if the extra ration is to cost 100 percent in dollars, then obviously dollars are being directly used to bolster up a nationalized industry.

In view however of the increased refining capacity in the country, it would appear that this statement by the Parliamentary Secretary requires further corroboration before it can be accepted in its entirety, and that the Chancellor of the Exchequer has not deliberately gone against his own preaching regarding dollar expenditure.

Whatever view is correct regarding this, the fact remains that a colossal increase in transportation costs such as has been levied, is bound to raise manufacturing costs which are so dependent in so many ways on transport.

New Book

Chemical Engineers' Handbook, prepared by specialists and edited by John H. Perry; 3rd edition; published 1950 by McGraw-Hill Book Co., New York; 1942 pages, 8 x 10 inches; weight unwrapped, five pounds; $15.

This large and closely printed volume is the product of 102 collaborators, comprising specialists in all branches of chemical engineering, with an advisory board of 16 men eminent as chemical industrialists and engineering educators. This array of talent and knowledge is enumerated as an indication of the quantity and diversity of information here available. The 30 sections deal in much detail with all matters that chemical engineers in every industry have to do with: mathematics; weights and measures; physical and chemical data of all common chemical substances; the physical and chemical principles governing their interactions; the flow of fluids and heat; evaporation and diffusion; gas absorption; distillation; sublimation; solvent extraction; dialysis; humidification, dehumidification; pumping; cooling; drying; adsorption; mechanical separations; grinding; high pressure techniques; process control; handling materials; materials of construction; fuels; furnaces; power; electricity and electrical engineering; accounting, etc. The book costs $15, but it is a library in itself.

Aluminum Plant Uses Gas

First aluminum reduction plant to be powered with natural gas has been built by Aluminum Co. of America at Port Comfort, Texas. All previous works have relied on hydroelectric power. At Point Comfort 30 million cubic feet of gas is being burned to create 2.75 million kwh per day of electric power for the plant. The plant will produce 114 million pounds of aluminum per year.

Polyphase Motor Booklet

A new bulletin on polyphase electric motors has been published by the A. O. Smith Corp. The bulletin, No. EM4-812, describes one to 75 horsepower horizontal motors, illustrating construction details in cross section and cutaway views. Among the features described in the bulletin are motor appearance, insulation, bearings, ventilation, mounting, service, frames and end bells, terminal box, rotors and machining. For copies write A. C. Smith Corp., motor division, Los Angeles 22, Calif.

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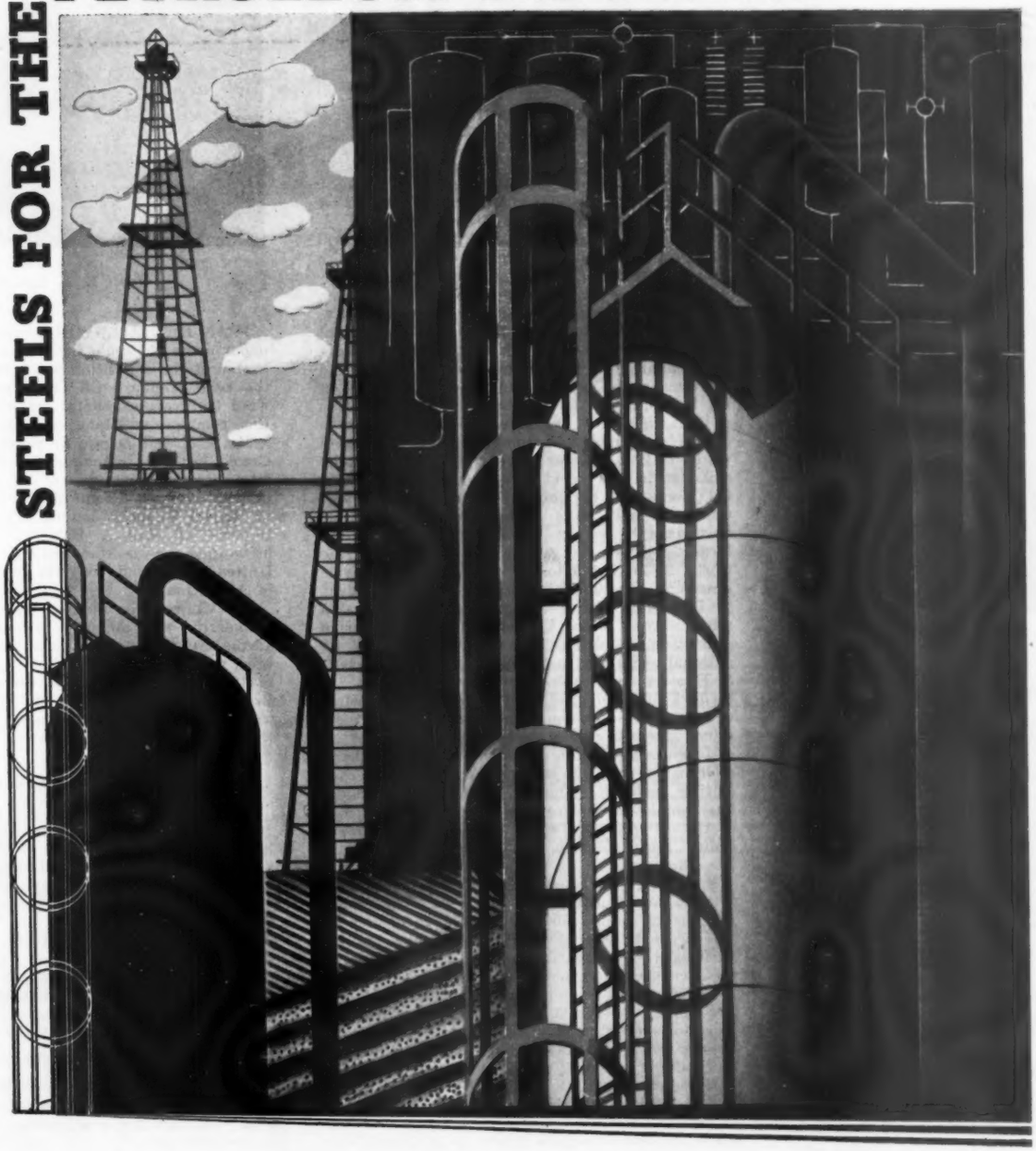

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This organisation has made a special study of steel requirements of the petroleum industry: plates for fusion welded vessels; constructional steel; forgings; alloy steels, including corrosion and heat-resisting types; etc. The Technical Departments will be pleased to discuss specific applications with manufacturers of petroleum equipment.

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US34

Mexico Increases Production

A 26 percent increase in crude production for the first quarter of 1950 over the corresponding period of 1949 is reported by Petroleos Mexicanos (Pemex), the Mexican petroleum administration. Crude output for the first three months of 1950 amounted to 16,709,789 barrels as against 13,274,776 barrels in the corresponding period of 1949. Direct operations by Pemex currently account for about 95 percent of total production, the remainder representing oil produced by Mexican and foreign companies which drill under contracts with Pemex.

Forty wells were drilled in the first quarter of 1950, compared with 30 wells in the like period of 1949. Refinery runs amounted to 15,077,087 barrels, an increase of nine percent over the 1949 first quarter output of 13,722,034 barrels.

E. M. Robinson

New Creole Management Members

Two new members have been added to the management committee of Creole Petroleum Corp. in Caracas. E. M. Robinson, whose appointment became effective June 1, represents the material and treasury departments and will be alternate representative for the marketing and accounting departments and the organization and procedures staff. His last prior assignment was as head of Creole's material department.

After education in accountancy and business administration, Mr. Robinson entered the oil business in 1924 with the Oklahoma Producing and Refining Corp. of Tulsa, and came to Venezuela for Creole (then Standard Oil Co. of Venezuela) in the accounting department at Caripito ten years later. In 1937 he left Venezuela for four years in Romania as comptroller of the Romana-American S.A. He became head of Creole's accounting department in 1945 and head of the material department in 1949.

Martin E. Jones, whose appointment took effect June 15, was formerly senior attorney of Creole. His duties on the management will be of special character, not representing any particular department. He first came to Venezuela in 1938, after having joined Carter Oil Co. immediately on graduation from the University of Oklahoma Law School in 1936. He left Creole in 1946 to become a member of the management of the Standard Oil Co. of Brazil and subsequently was transferred to the legal department of SONJ in New York.

Brazil's Five-Year Plan

Brazil's Five-Year Plan, better known as the SALTE PLAN, was sanctioned by President Dutra on May 18. The program provides for an expenditure during 1950-54 of U. S. $1,235,500,000 for raising the national standard of health, expanding agricultural production, improving transport systems and increasing supplies of electrical energy and fuel.

The section dealing with petroleum allots U. S. $82,225,000 for intensive prospecting in various sedimentary basins, purchase of materials for drilling and complementary work, installation of refineries and storage tanks.

The program of road building, to be carried out at a cost of U. S. $166 million, is expected to stimulate motor transport and lead to a big increase in the consumption of petroleum products; 35 new roads are to be built and many others are to be made suitable for motor traffic in all parts of the country.

Other sections of the plan provide for intensive mechanization of farms, building and equipping sea and river ports and industrialization of rural districts, all of which will increase the demand for petroleum products.

Exploration Consultants Form Partnership

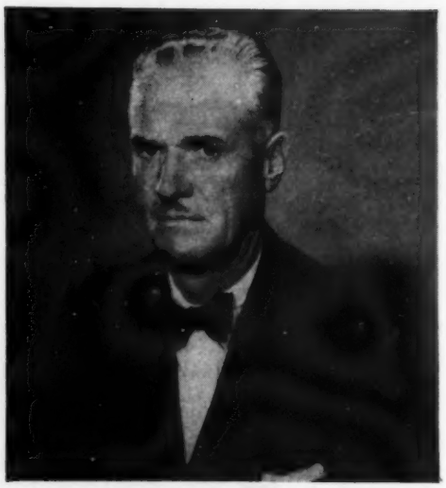
T. A. Manhart, Clark Millison and B. W. Beebe announce the formation of an exploration consulting partnership, Manhart, Millison & Beebe, with offices in Tulsa, Oklahoma.

The firm will perform all types of geological and geophysical services in domestic and foreign areas, with particular emphasis on programs which require coordination and direction from inception to completion. Among current activities are services as geophysical and geological advisers to Petroleos Mexicanos, the government oil company in Mexico, and the direction and coordination of several exploratory programs in the United States and Canada.

T. A. Manhart graduated from the Colorado School of Mines and completed post graduate work in 1932. After a year as assistant seismologist in the geological department of Shell Oil Company, he joined Seismograph Service Corp. as party chief. Through the years that Seismograph Service expanded to become the largest seismic contracting organization in the world, he advanced to the post of executive vice president. In 1949 he organized and is president of Petroleum Consultants, Inc., which operates seismic crews in the United States and performs consulting geophysical services. He served as national secretary and treasurer of the Society of Exploration Geophysicists in 1947-48.

Clark Millison graduated from Columbia University and Oklahoma University in 1927 and joined Shell Oil Co. as a geologist. In 1936 he resigned as regional geologist for the southern midcontinent area to become an independent consulting geologist. During the past 14 years he has completed exploratory assignments in most of the oil-producing areas of the United States, Cuba, Peru, Mexico, Colombia, Panama and Venezuela.

B. W. Beebe graduated from the University of Wichita and California Institute of Technology. In 1934 he joined Shell Oil Co. as geologist in Kansas, and after various exploratory assignments for this company he became assistant to the vice president in charge of exploration. In 1938 Mr. Beebe joined British American Oil Producing Co. In 1942 he organized the exploration department of Bay Petroleum Co. in Denver as chief geologist and vice president, and in 1947 he became exploration manager for Anderson-Prichard Oil Corp. For the past several years he has specialized in the coordination of geological and geophysical programs and has presented several papers before the geological and geophysical societies on this phase of exploration.



Ivan E. L. Caldwell

IVAN E. L. CALDWELL manager of the sales department of Creole Petroleum Corp., is leaving that post for a position with the management of the Esso Standard Oil Co. (Puerto Rico), while Fred C. Rawson, general manager of the Puerto Rico company will take his place in Caracas.

Mr. Caldwell began 13 years of service with Creole as sales manager for the Federal District, becoming manager of the sales department in 1945. He has a total of 28 years of experience in the oil business, having begun in 1922 with Imperial Oil Ltd. in Hamilton, Canada. Later he worked for the Standard Oil Co. (N.J.) in the United States and with the West India Oil Co. in Argentina.

Mr. Rawson graduated from Northwestern University and did post graduate legal study at the University of Nancy, France. He began work with Standard Oil Co. (N.J.) in New York in 1925 and was with the Standard Oil Co. of Brazil from 1926 to 1944, and from 1944 to 1950 was with the Esso Standard Oil Co. (Puerto Rico) as a marketing executive.

New Pipeline in Manitoba

Winnipeg Pipe Line Company Ltd. has been organized to construct a pipeline which will connect the Interprovincial line at Gretna, Manitoba, with the refinery which Imperial Oil Ltd. is building at Winnipeg. Completion of the line is expected by late fall or by the spring of 1951 at the latest.

The 75-mile line will be 10 inches in diameter. It will cost some $2.5 million. Initial throughput will be about 14,000 barrels a day, although the line will be capable of handling up to 30,000 barrels daily. One pumping station will be required and will be built at Gretna, adjacent to the Interprovincial Pipe Line Company's station there.

Pipe has been ordered in Britain and is being brought to Montreal for shipment by rail to Manitoba. Contract for construction of the line will be awarded shortly. The company is a wholly-owned subsidiary of Imperial.

Left to right: T. A. Manhart, Clark Millison, B. W. Beebe

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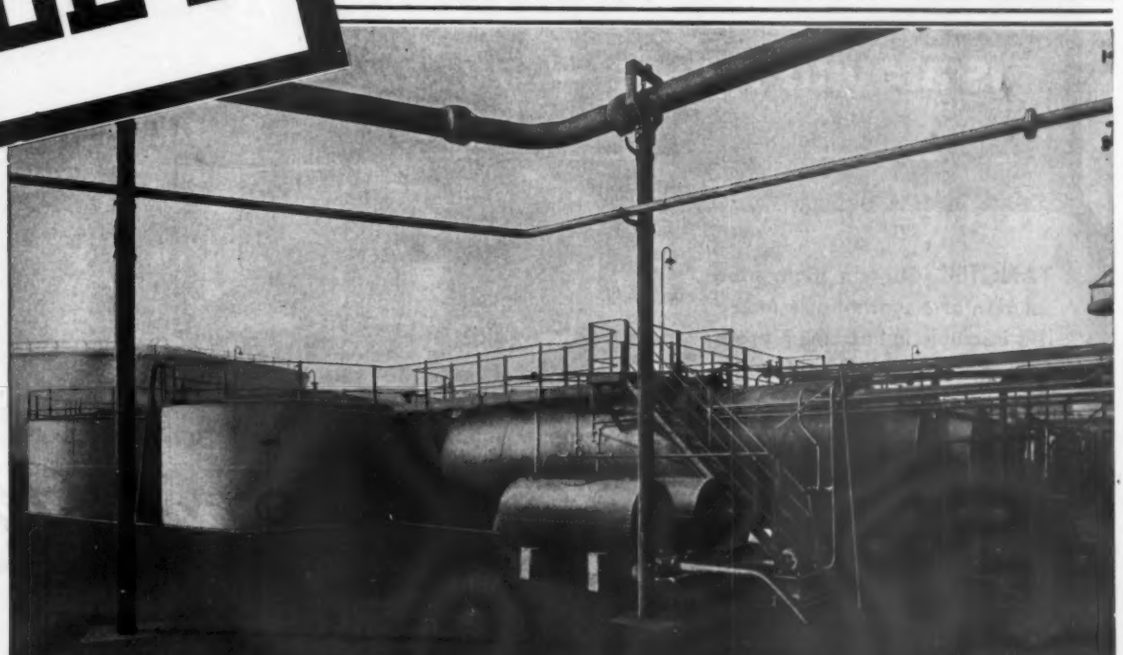

Part of a battery of ten, electrically-welded steel storage tanks 9'x0" dia. x 30'0" long with tank in background 25'0" dia. x 10'0" deep. Erected at Ellesmere Port, Cheshire. (Photograph by courtesy of Lobitos Oilfields Ltd.)

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R.B. W100

Pipeline Booklet

With the assistance of scores of pipeline companies, Rockwell Manufacturing Co. has published a booklet of special interest to pipeline engineers which contains more than 200 illustrations including photographs and pipeline system maps. Data has been included on the latest arrangements of piping on main lines, in compressor and pumping plants, at tank farms, bridge crossings, town border stations, meter and regulator stations, way stations and at terminals. Details are given pertaining to valve controls on manifolds, main lines, pumps and compressors, etc. One section is devoted to the operation of automatic closing valves for emergency service.

Data is given on power-operated valves as well as tables of sizes, pressure ratings and end-to-end dimensions of all Nordstrom pipeline valves. High head extensions, locking devices and new details about lubricated valves and automatic lubrication are presented for reference. Rockwell Manufacturing Co., 400 North Lexington Ave., Pittsburgh 8, Pa., will send copies of Bulletin V-210 on request.

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Shell Starts Drilling in Queensland

Shell (Queensland) Development Pty. Ltd. commenced drilling a deep test well May 1 at Morella, 100 miles south of the Springsure rail head. The test is the result of a search for oil in Queensland begun in 1940, which has included geological and geophysical investigations carried out over the surface of vast areas of central and western Queensland. Much of the territory was photographed from the air and then mapped. The work was interrupted by the war in 1943 but recommenced in 1946.

The company had selected the present site for deep test drilling in September 1949. When the well has been completed, Shell will have spent over one million pounds on its search for oil in Queensland.

Du Pont Moves Chicago Offices

The Chicago district office of the Petroleum Chemicals Division of E. I. du Pont de Nemours & Co. has moved to new offices in the Willoughby Tower, No. 8 South Michigan Boulevard, Chicago 3, Illinois. The new telephone numbers are RAndolph 6-8630 and ANdover 3-7000. The district laboratory remains at 1025 So. Wabash but is served by the new telephone numbers.

Gen. Walter B. Pyron

GENERAL WALTER B. PYRON, vice president of Gulf Oil Corporation, has retired after more than 43 years of service with the company. He recently returned from London where he was one of the directors of the Kuwait Oil Co., Persian Gulf producing company jointly owned by Gulf and Anglo-Iranian Oil Co. Ltd.

General Pyron was for many years in charge of production in Louisiana, West Texas, South Texas and Mexico, and on the West Coast. In 1940 he went into active service with the United States Army and in 1941 was called to Washington to help speed up the 100-octane gasoline production program. He and Admiral Carter formed the Petroleum Board, which standardized specifications and the procurement procedure for petroleum products, and coordinated the movement of tankers for the allied nations.

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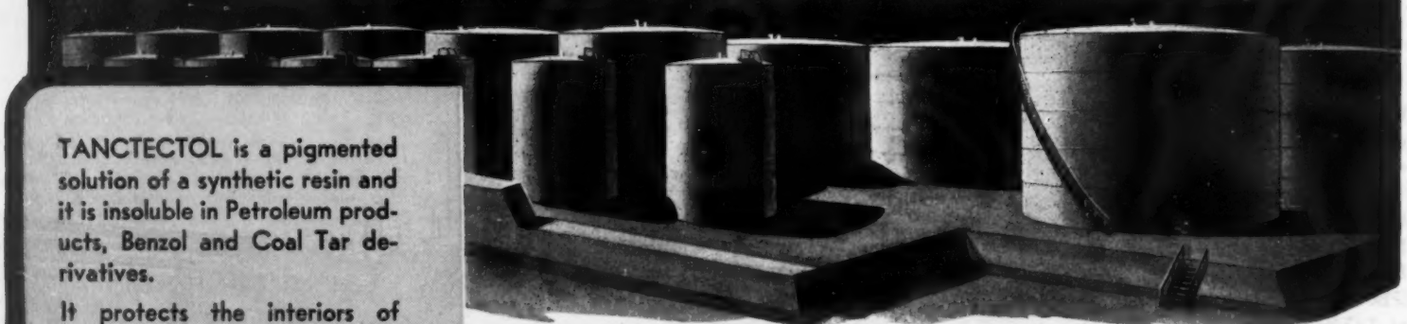

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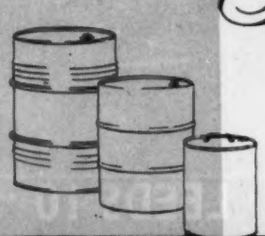

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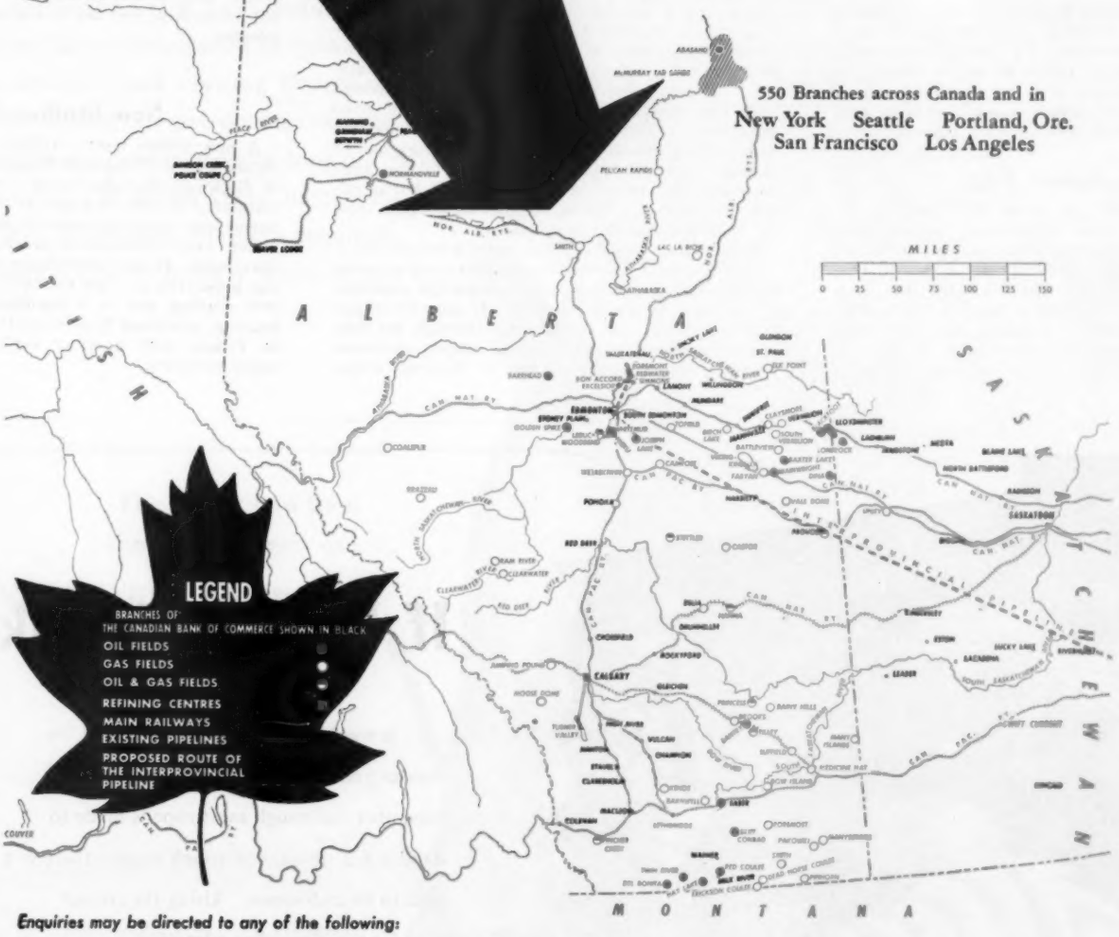

Enquiries may be directed to any of the following:

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The Canadian Bank of Commerce
Head Office, Toronto, Canada

Mr. J. P. R. Wadsworth, *Superintendent*
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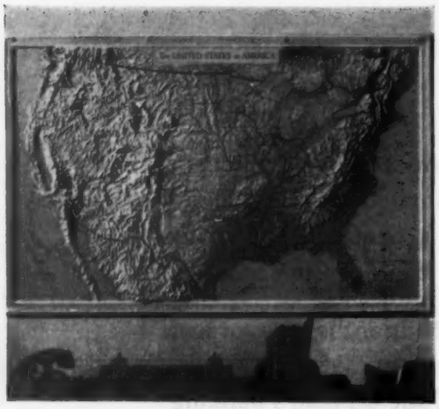

A plastic relief map of the United States has been produced by Aero Service Corp. using the same techniques and materials which were employed a year ago in the relief map of Venezuela which was commissioned by Creole Petroleum Corp. The Venezuela map was used by Creole as part of its public relations program and to aid in that country's education. The United States map is lithographed in 11 colors to aid in visualizing topographic features, and the vertical scale is exaggerated for the same reason. The large map pressed in vinylite weighs only 2¼ pounds.

European Trip

D. T. (Mickey) O'Connor left recently for Europe and the Near East where he will visit all of the oil-producing areas on behalf of the Shaffer Tool Works, M. J. Crose Mfg. Co. Inc., Drilling & Service Inc., Mayhew Machine & Supply Co. and Frank Wheatley Pump & Valve Mfr. During Mr. O'Connor's absence, his New York office will be under the supervision of Ross R. Chenault who recently joined his organization.

Underground Coal Gasification

The second large-scale coal gasification experiment conducted by the Alabama Power Co. and the U. S. Bureau of Mines has revealed much new data which was reported at the Biloxi, Miss., meeting of the Interstate Oil Compact Commission. Milton H. Fies and James L. Elder indicated that the new experiments suggest economic possibilities in the background burning of veins of coal for the production of synthetic liquid fuels or to obtain energy for electric power.

The first large-scale experiment at the Gorgas mine in Alabama showed that a solid underground coal seam, once it is set on fire, can be kept burning until it is completely consumed, and that by varying the conditions, a gas having a heating value of 100 Btu or more per cubic foot can be produced simply by blowing in air.

On the basis of this experience a second, larger-scale experiment was designed and is now in progress on an isolated bed of coal 42 inches thick, relatively level and covering about 100 acres on which is an over-burden of about 150 feet.

The experimental unit consists of two straight passages 10 feet wide, 1,540 feet long and separated by a solid pillar of coal 10 feet thick. This passage is connected with the surface at one end by an outcrop seal and at various points by five vertical boreholes of 18 to 28 inches in diameter. The entire length of the passage is divided into five sectors, each of which can be fired separately. The present firing operations are done with a simple blast of air, although use of steam is contemplated. In addition to the large boreholes, a number of test holes are bored offside in order to observe, by thermo couples, how the underground fire is spreading.

Combustion was started in large borehole No. 1, and products of combustion are taken out at large borehole No. 2. At ten-day intervals the direction of the blast of air is reversed. It soon developed that much gas was by-passing through crevices in the over-burden, but this was largely overcome by injection of fluidized sand in the rock above the passage. When the burning sector had become well heated up, the outlet holes were operated to 1,600° to 2,400° F, and the hot gases could be used to generate steam or operate a gas turbine. Heat balances run on the operation show that more than 50 percent of the heat of combustion of the coal is brought to the surface in the effluent gases.

Samples of gas taken from test holes close to the burning coal faces contained up to 8.5 percent CO_2, 11.4 percent H_2, 15.5 percent CO, CH_4, and 62.4 percent N; very little free oxygen was found. The gas had a heating value of about 110 Btu per cubic foot.

A recent survey of the operation showed that between March 1949 and March 1950, an area 80 to 130 feet wide and more than 400 feet long had been burned out in the sector between outlet holes Nos. 1 and 2, and that 5,125 tons of underground coal had been consumed.

This is taken to indicate that there is no limit to the quantity of coal that can be utilized from a given initial passage, and that no difficulty is encountered in maintaining the underground fire. The survey showed that, as the coal is burned away, the overlying rock becomes heated and the rock roof collapses, but not in such a way as to disturb the combustion process.

New Stuffing Box

A new orifice meter stuffing box has been designed by the Pittsburgh Equitable Meter division of Rockwell Manufacturing Co. to reduce meter maintenance and leakage at the pen shaft between high-working-pressure zones in the manometer and atmospheric-pressure zones in the chart case. It has been shown leakproof at working pressures as high as 5,000 psi. Heart of the new stuffing box is a combination packing and bearing, machined from a synthetic plastic known as Teflon, with a waxy surface and cold flow under pressure.

Venezuelan employee operating drilling rig—A Shell photograph

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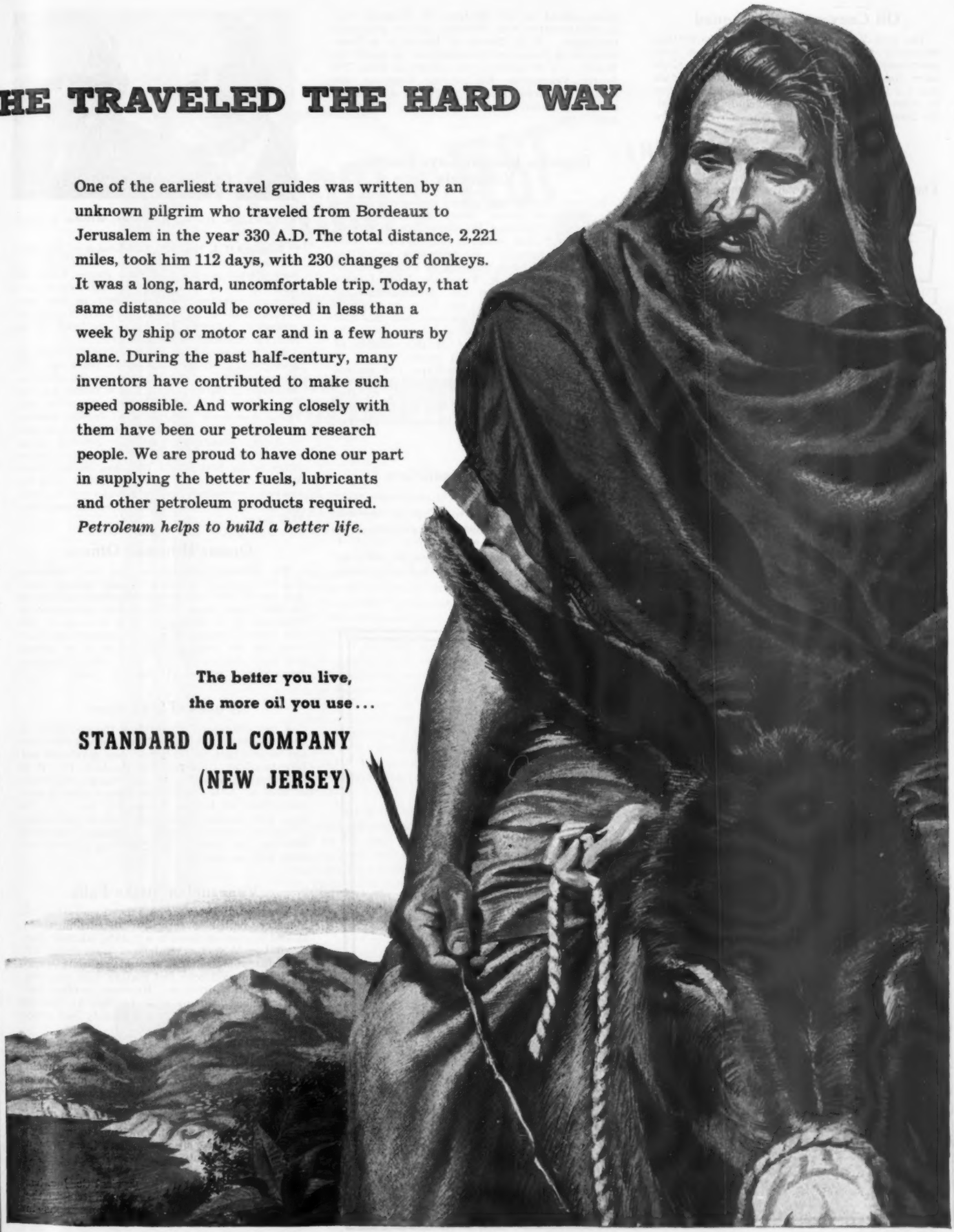
One of the earliest travel guides was written by an unknown pilgrim who traveled from Bordeaux to Jerusalem in the year 330 A.D. The total distance, 2,221 miles, took him 112 days, with 230 changes of donkeys. It was a long, hard, uncomfortable trip. Today, that same distance could be covered in less than a week by ship or motor car and in a few hours by plane. During the past half-century, many inventors have contributed to make such speed possible. And working closely with them have been our petroleum research people. We are proud to have done our part in supplying the better fuels, lubricants and other petroleum products required. *Petroleum helps to build a better life.*



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Oil Convention Postponed

The first Venezuelan National Oil Convention, originally announced for June, has now been postponed until August or September, to allow more time for the assembly of statistical data and for the extension of invitations to observers of other producing nations, including the Middle East. Preparations for the convention are going ahead in the Ministry of Fomento and, in collaboration with Fomento, in the producing companies. H. J. Struth of Dallas is in Venezuela on a three-month assignment to assist the Ministry in its assembly of statistical data. The fourth Venezuelan Engineering Congress was held in Caracas, May 7 to 14, to discuss engineering questions, including those related to petroleum.

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Maurice Kamen-Kaye Leaves Venezuela

Maurice Kamen-Kaye, chief geologist of Caracas Petroleum (joint owner with The Texas Company of Sociedad Petrolera Las Mercedes), left for the United States on May 15 after twenty years in Venezuela. He will open consulting offices in the Lincoln Building in New York. Dr. Kamen-Kaye went to Venezuela from London in 1930 as a geologist and paleontologist for Caracas Petroleum. He was an early explorer of the plains of central Venezuela, and this field work has led to his close association with the discovery and development of the oilfields of Guarico during the last ten years.

His wife, Dorothy Kamen-Kaye, has become well known as the writer of books and newspaper articles interpreting Venezuela to foreigners, a work of education for which she was recently decorated by the Venezuelan government.

Colombian Oil Operations

Consumption of oil products in Colombia during 1949 amounted to seven million barrels. Imports, consisting mainly of aviation fuel and motor gasoline, were roundly one and a half million barrels valued at $5,400,000. Crude oil production during the year was 29,700,000 barrels, of which 24,200,000 were exported.

Left to right, Harold W. Fisher, William J. Haley

WILLIAM J. HALEY, coordinator of the refining operations of Standard Oil Co. (N.J.), has been elected president of Esso Export Corp. He succeeds Frank M. Balling who will remain as a director pending his retirement in the near future. Harold W. Fisher, formerly deputy coordinator, succeeds Mr. Haley as head of the refining coordination department.

The new president of Esso Export joined the Jersey Standard organization 36 years ago. His career includes service in executive capacities at refineries at Bayway, N. J., Baton Rouge, La., and Charleston, S. C., and with Latin American affiliates. Appointed coordinator of foreign refining activities in 1944, Mr. Haley became coordinator of Jersey Standard's worldwide refining operations in 1947. He served with the United States Navy in the first World War, and during World War II was chairman of the Caribbean Area Petroleum Committee, playing a major role in meeting the fuel demands of the armed services from that area.

Opens Houston Offices

The Refinery Maintenance Co. Inc., engineers and constructors of refineries and natural gasoline plants, now has permanent offices in Houston at 4604 South Main Street, it was announced by President F. J. Buckner. Now in work at the new office is engineering and materials procurement for the large gasoline plant to be erected for Shell Oil Co. at Elk City, Okla. Company headquarters remain at Compton, Calif.

Fuel Oil Stabilizer

A new inhibitor for retarding the formation of sediment and maintaining color during the storage of distillate fuel oils has been developed and introduced by Universal Oil Products Co. It is effective in blends of virgin and cracked distillates as well as in the individual components in concentrations as low as 0.002—0.02 per cent. It does not increase Conradson carbon and burns completely, leaving no ash. A unique property is its ability to promote rapid settling of tank bottoms and sediment.

Venezuelan Strike Fails

A nation-wide strike in the Venezuelan oil industry halted practically all drilling and slowed production down to a trickle, starting May 3. Before it was over, drillers were doing KP in company mess halls, accountants were working in camp laundries and doctors were mopping down hospital corridors. However, drilling had been resumed in many fields by May 11, though with incomplete crews, and normality had practically been restored.

The strike was carried out in spite of government warnings and with no attempt to cite grievances through established legal channels. The government charged that the strike was the work of Communist Party leaders. There were indications that the leaders of the strike hoped for a popular insurrection or at least a general strike. Handbills inciting to sabotage and violence were circulated, but there was a minimum of incidents.

C. C. LISTER of United Geophysical Co. Inc. has recently returned from an extended trip to the Middle East, inspecting United's operations in that area.

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(N.P.L.)

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THE JOHNSTON *all purpose* GUN PERFORATOR

Gives you maximum PORTABILITY!

THE JOHNSTON GUN PERFORATOR is flexible in operation and so completely portable that the entire unit can be transported in your regular field car! For each perforating job you need only the Firing Head and the Perforating Gun Sections—no special depth measuring devices, firing equipment or extra assembling tools are necessary.

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FLEXIBILITY and PORTABILITY

are only two of the *many* outstanding advantages of the Johnston "SHOOT-N-TEST" All Purpose Gun Perforator. Here are other important Johnston features to consider when contemplating Gun Perforator equipment . . .

SAFE gun perforator operation! The Johnston Gun Perforator will not fire until subjected to *both* in-the-hole hydrostatic pressure and positive rotary and vertical manipulation of the pipe string by the driller.

POSITIVE FIRE of all projectiles! The safe, fool-proof hydrostatic firing principle of the Johnston Gun Perforator coupled with the flash-hole design of the Perforating Gun Sections assures positive fire of all projectiles.

ANY NUMBER OF PERFORATIONS possible! Any number of four, five or six-shot Perforating Gun Sections can be attached to the Johnston Gun Perforator Firing Head to provide the *exact* quantity of perforations needed for each job.

EXACT POSITIONING in producing zone! Accurate placement of the Johnston Gun Perforator at the *exact* depth for perforating is easily determined by pipe-in-the-hole tally. No rigging-up of special measuring devices is necessary.

MINIMUM OF EXPENDABLE SUPPLIES! The Johnston Gun Perforator needs only a minimum of loading supplies for each perforating job. The Perforating Gun Sections require only seals, powder charges and projectiles for reloading.

FAST, EASY MAINTENANCE! The Johnston Gun Perforator is outstanding for its simplicity of operation and trouble-free construction. The simple procedure of disassembly, cleaning, loading and reassembly can be done right on the rig floor.

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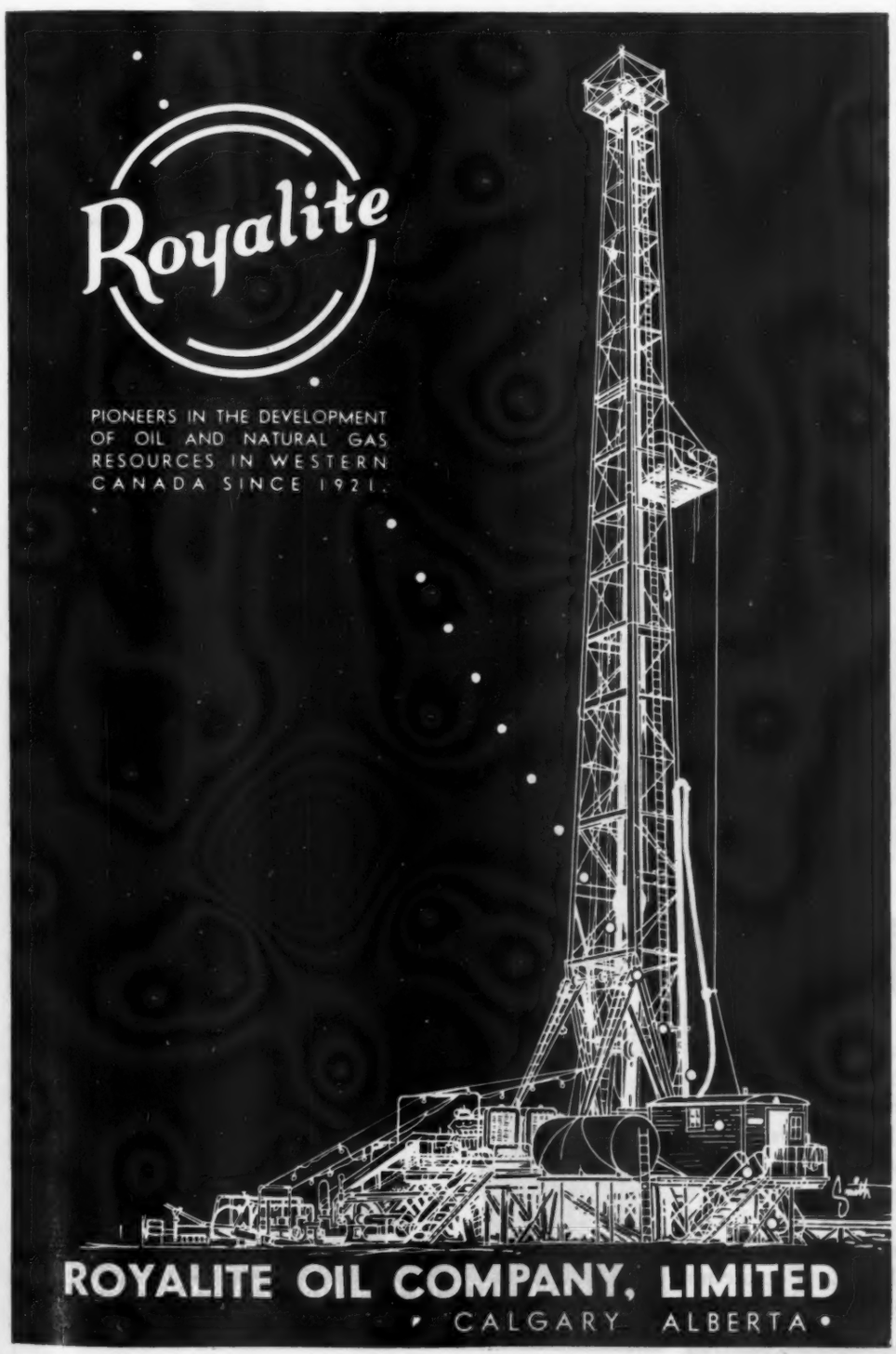
James Kewley Honored

The Honorary Fellowship of the Institute of Petroleum, the Institute's highest class of membership, was awarded to 70-year-old James Kewley at the recent annual general meeting. Mr. Kewley has had long associations with both the oil industry, as an employee of 34 years' standing with the Shell organization, and with the Institute of Petroleum. As president of the Institute at the time of the First World Petroleum Congress in London in 1934, he devoted all his energies toward the undoubted success of that event. He was also very active both in organizing the second congress in Paris in 1937 and in widening the Institute's membership and activities when it became the Institute of Petroleum in 1938.

Mr. Kewley was Shell's chief chemist during the 21 years preceding his retirement in 1940. He joined the company in 1906. In 1913 he was appointed manager of the new refinery of the Anglo-Egyptian Oilfields at Suez, and two years later was called home to take charge of the refinery and installation at Porteshead, near Bristol, whose production of toluene from straight-run Borneo benzene partly overcame the critical shortage of high explosives in the spring of 1915.

New GE Sales District

General Electric Co. has established a new district for apparatus sales with headquarters at St. Louis. G. F. Maughmer will be manager. The new district comprises St. Louis, Kansas City and Omaha territories.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Edward B. Heyden

Edward B. Heyden

Edward B. Heyden, 52, head of Graver Construction Co. and vice president of Graver Tank & Mfg. Co. Inc., died at his home in Cranford, N. J., on April 18, 1950. He had been associated with Graver since 1946 and had personally supervised Graver construction projects. For 14 years previously he was general superintendent for The Lummus Co. During World War II he was responsible for erection amounting to approximately $400 million and for five consecutive years flew more than 100,000 miles a year, with a peak of 165,000.

After his service in World War I, Mr. Heyden went to Mexico where he worked for AGWI Oil Co. (Shell) erecting tanks in the oil fields. He later went into business for himself contracting tank erection and operating a silver mine. When the mine started producing, Pancho Villa appeared and invited Heyden and his partner out of Mexico at gun point. Back in the United States, Mr. Heyden served a number of oil companies on engineering projects and was with E. B. Badger & Sons at Boston as general superintendent of all their erection.

To Build Hypersorption Plant

Foster Wheeler will build for the Dow Chemical Co. its second hypersorption unit. The new unit will have a charging capacity five times that of the first unit which has been operating successfully since June 1947. Three pure product streams, C-1's and lighter from the top, C-2's as the middle and C-31's and heavier as the bottom fraction, will be separated from the cracking plant effluent.

To Supervise Two Areas

Hosea P. Hearn, superintendent of Halliburton Oil Well Cementing Co., Denver, representing the Rocky Mountain area, has been recently assigned an additional division which includes the Pacific Coast area. His appointment as superintendent of the Pacific Coast area is for an indefinite period, in view of the illness of C. T. McGuire, who is on a temporary sick leave. Mr. Hearn will maintain his residence in Denver.

Heat Engineering Anniversary

A special June issue marks the twenty-fifth anniversary of "Heating Engineering," a magazine published monthly by Foster Wheeler Corp. for general trade distribution and for classroom instruction in more than 100 colleges. The magazine, with a free circulation of about 16,000, has been completely redesigned as to makeup and layout. The anniversary issue contains highlights of previous articles, including one on the first complete distillation unit for an oil refinery which was erected for the old Marland Oil Co. (now Continental) at Ponca City, Okla., in 1926.

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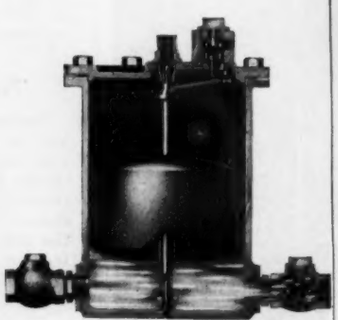

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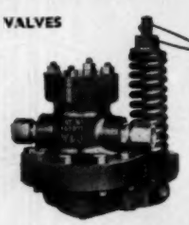

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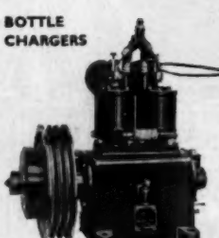
BOTTLE CHARGERS



Single-stage, heavy duty Bottle-charging Air Compressors for pressures up to 450-lbs p.s.i. Displacement range 2.4—8.7 c.f.m. Machined from finest materials to interchangeable limits. Multi-stage Compressors up to 30 c.f.m. Leaflet No. 41 gives full details.

Technical advice on pneumatic problems gladly given on request

SPECIALISTS IN COMPRESSED AIR EQUIPMENT & HIGH PRESSURE RAM PUMPS

Making "dry holes" pay off

THIS SPECIAL ROTARY RIG is not intended to produce anything but "dry holes." It is an important part of our research equipment for testing new rock-bit designs. With it we can simulate field-drilling practices encountered in any part of the world.

This equipment enables us to produce the effects of drilling at depths of over 20,000 feet, loads of over 100,000 pounds, and angles up to 10 degrees. Variable rotary speeds are available up to 400 rpm. Special instruments translate the forces applied. This careful research pays off in the field by enabling us to predict how one of our bit designs will work in a particular formation. Trial and error in the field is reduced to a minimum.

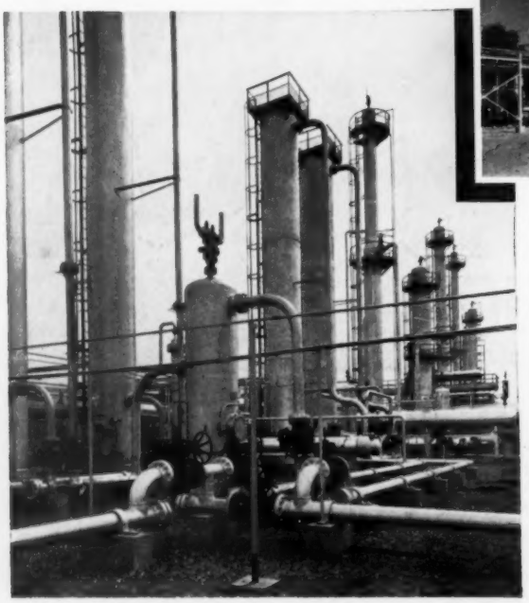
This is another example of the intensive research program—started in 1911—which Hughes Tool Company conducts in a never-ending effort to design more efficient rock bits. Rock bits that will enable the drilling industry to "make more hole faster." The years of combined experience gained in the laboratory *and field* have given Hughes Tool Company the greatest amount of "know-how" in the industry. This *"practical experience"* is at your service *at any time on any job, anywhere!*

HUGHES
TOOL COMPANY
HOUSTON, TEXAS

Hughes Rock Bits—World Standard of the Industry

Wyatt's PRODUCTS IN FRANCE

Designed by and built for Hudson Engineering Corporation for the Regie Autonome des Petroles plant at St. Gaudens, France.



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